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Science and Art Gossip.

THE course of lectures by Mr. R. A. Proctor, at St. James's Hall, of which the first is to be given on Wednesday, March 21, is the same, but brought up to date, which Mr. Proctor has delivered in all the chief cities of the United States, Canada, Victoria, New South Wales, South Australia, Tasmania, and New Zealand. The opening lecture, on the Birth and Death of Worlds, has been delivered now some four hundred times, yet never twice in the same exact form, having never yet been committed to paper. It closes with the celebrated dream by Richter, as admirably translated—or rather transformed—by our own prose poet, De Quincy.

MR. PROCTOR lectured on the Great Pyramid, at the London Institution, on Monday, March 12, to a crowded house, many of the audience being unable to obtain seats. He showed how the study of such a building throws light on the nature of a people, their system of government, religion, superstitions, and general character. He also showed that the various theories according to which the Great Pyramid has been described as Tomb, as Temple, and as Observatory, all have their element of truth.

ACCORDING to the *Newcastle Daily Chronicle*, a very interesting competition is going on at Warkworth Harbour, where, in consequence of the great pressure of business, the electric light is required to facilitate the loading of coal vessels at all hours of the day or night. "The Hammond Brush Lighting Company have put up six lamps and the Jablochkoff Company ten lamps, each connected with a Gramme dynamo machine. Both lights were put to a test the other night, each being used a quarter of an hour, and then their combined illuminating power was tested. The result in each case appeared to be very satisfactory, but the result of the competition will not be arrived at until a month's trial." Another contemporary hears that the Jablochkoff candles have given great satisfaction, and that they are likely to be adopted permanently.

IN Canada, the Welland Canal, connecting lakes Erie and Ontario, has been open to traffic for some time, and steamers of very considerable tonnage now pass from one lake to the other. This canal is but one section of a gigantic waterway which is intended to place the Great North-West in direct communication with Europe. Great efforts are now being made to deepen and reconstruct the various canals that now lead between Kingston and Montreal, and when a sufficient depth has been attained—uniform with that in the Welland channel—it will become possible for grain vessels to load in Manitoba and unship in Liverpool or London. Although this project attracts little attention here, it cannot fail, says a contemporary, to prove of immense consequence to the well-being of our colony and ourselves.

THE gross tonnage of steel ships built last year is over 14 per cent. of the total iron and steel gross tonnage for the year. In 1881 it was 11 per cent.

ACCORDING to news from St. Petersburg, the search for the North Pole Expedition Dymphna has now been pronounced hopeless. The Samoyedes, lately visiting Liapina, are unanimous in asserting that no trace of ship or crew can be found. The Samoyede country, we may remind the reader, is an enormous frozen desert, forming the Northern boundary of Asia, and occasionally traversed by the most miserable of all known Nomadic races. It is remarkable that the Samoyedes, originally forced back from the warmer Asiatic zones by the Mongolians, have remained almost untouched by Russian civilisation. They remain invincible Pagans of the old type, and, like the Finns, whose verbs totally want a future tense, these wretched savages drag out a cheerless existence, the great aim of which, rarely gratified, is to be warm enough and to eat to repletion.—P. R.

THE Royal Aquarium Electric Exhibition is rapidly becoming more extensive. There is, apparently, something very wrong with the Ferranti exhibit; the third dynamo has been heated and rendered useless. Is the speed too high, the mechanical efficiency too low, or is the engineering unequal to the task?

THE Edison exhibit remains at most second best. The company make a great mistake in exhibiting only eight-candle lamps, which are unable to afford sufficient relief to the very sombre-looking decorations accompanying them.

AT an exhibition of the Edison electric light, opened in Glasgow recently, a 300-candle incandescent lamp claimed special notice. It was 2 ft. 6 in. high, and 15 in. in diameter.

MESSRS. SIEMENS BROS. have undertaken to instal on board the Cunard steamer *Aurania* two Siemens dynamos and 500 20-candle-power Swan lamps.

IN the Strand, the "Gaiety" bar will be illuminated by means of thirty Jablochkoff candles and forty Swan lamps. This is, in our opinion, a very happy combination.

THE Executive of the International Fisheries Exhibition have, it is said, decided to light their galleries by electricity, and arrangements have already been made for the illumination of fully two-thirds of the area. The committee will thus be enabled to keep the exhibition open

later than was originally intended. Messrs. Davey Paxman & Co. have undertaken to provide 600 indicated horse-power for the purpose. One of the engines will develop 350 horse-power. That the Commissioners should have entrusted the whole of the work to one firm is somewhat unusual, and the decision implies a high and well-deserved compliment to the manufacturers.

The Loisettian School of Memory has been prominently brought to my notice by one of my assistants, who is now going through the course of study as taught by Professor Loisette, and he confidently states that this system is thoroughly genuine, and fully bears out in every way the many testimonials he has seen regarding it. I should think Professor Loisette's art of "Never Forgetting" of great importance to students of all classes.

Parasites in the Human Body.—Recent investigations have added greatly to our knowledge of the more highly organised parasites of the helminthoid type. For example, it has been ascertained beyond doubt that the blood-vessels of a human being capable of performing his daily avocations may contain from 20,000 to 30,000 minute embryo nematoid worms. A physician at Calcutta demonstrated this with regard to persons in that climate. Numbers of individuals so affected suffer from chyluria or elephantiasis in one or other of its forms; but this is by no means universally the case. Researches have also revealed the curious fact that these teeming multitudes of nematoids lurk in some unknown recesses of the vascular system during the daytime, and that only as night approaches do they wander at large through the vessels generally. Experts assure us that a single drop of blood taken from a prick of the finger at midnight in a person so affected may contain as many as 200 embryo nematoids, while many drops similarly obtained at midday will not reveal a single worm.—*Times.*

The result of the *Freethinker* trial is singularly illogical. A small meshed net has been used to catch prey for which a net of another sort is needed, but does not exist. As Justice North explained the law of Blasphemous Libel—and even more clearly as Justice Stephen interprets it—it is manifest that in these days the law is an anachronism. It covered the offence of the accused, but it covers also many acts which are not offences at all, save as this law makes them such. That, as Justice North said, things written by many of the most esteemed thinkers of the age are utterly unlike the coarse and vulgar effusions brought before him, is not only true, but obvious; yet they are like in being within the actual range of the preposterous law he had to administer. Moreover, the punishment which the law empowered him to inflict is certainly inappropriate for that part of the offenders' actions in which these were not akin to the writings in question. That part was their vulgarity and offensiveness of tone; but our laws do not give any one a term of imprisonment with hard labour for even the grossest vulgarity short of absolute indecency.

No one doubts that the penalties under the Blasphemy Law were originally made heavy as against the publishing of views inconsistent with the State religion; nor does any one doubt that the attempt to inflict such penalties on those whose published opinions are obviously inconsistent with that religion, would at once lead—as the *Times* pointed out—to the repeal of a law which is practically obsolete and dead. The persons brought under the operation of the law in this case had offended grossly against propriety. They had exhibited—as the *Times* puts it—hopeless and irredeemable vulgarity. But the law under which sentence was pronounced against them is not a law against vulgarity.

The coarse vulgarity of the attack made in the *Freethinker* upon opinions held in reverence by thousands of worthy persons, though not much worse than the scurrility of Mr. Talmage's attack on some of the greatest men of science of the day—was deserving of severe censure, even of punishment. Such writings exhibit the very vice which, I suppose, the *Freethinker* was chiefly intended to oppose—intolerance; and in a most objectionable, because mean and cowardly, form. Setting aside the vulgarity of all such attacks, whether made by Christians on Jews or by Jews on Christians, by Protestants on Catholics or by Catholics on Protestants, or by those in fine who hold any special doctrine on those who believe differently, there is the wish to annoy and irritate—failing the power to inflict as of yore material injuries on those of different views. This should be regarded in every well-ordered State as a punishable offence. It might be called even "blasphemous libel," if the words were interpreted to signify all scoffing at ideas held in reverence by others.

The present law of Blasphemous Libel—so called—belongs to times when intolerance was mistaken for religious fervour. But it should be remembered that in all ages there are men of the Stiggins and Chadband breed, who are only too glad to find in such a law the means of making easy pretence to religious zeal. It matters little to them that men of sense—always rather in the minority—recognise in their pretended fervour the clearest evidence of knavery. Hundreds of feeble-minded folk imagine otherwise, and consider the guzzling selfishness of a Chadband, the bibulous bleatings of a Stiggins, and the noisy brutality of a Honeythunder, to be the inventions of the enemy. So long as this is so, so long as some money and an easy reputation for zeal are to be made by denouncing others, while mere persistence in well-doing is slow to tell, there is always some degree of danger in leaving obsolete laws about religion unrepealed.

"The Rev. Dr. S. Wainwright, President, and Mr. Alexander Scott, Hon. Secretary of the Society for the Suppression of Blasphemous Literature, write:—'We propose to get up cases, as our funds will allow, against Professor Huxley, Dr. Tyndall, Herbert Spencer, Swinburne, the author of 'Supernatural Religion,' the publishers of Mill's works, the publishers of Strauss's works, Leslie Stephen, John Morley, the editor of the *Jewish World*, Dr. Martineau, and others, who by their writings have sown widespread unbelief, and in some cases rank atheism, in cultivated families.'"—*Manchester Examiner and Times.*

At a meeting held in Chambers-street Hall, Edinburgh, on March 11, the following resolutions were adopted:—"This open meeting of Edinburgh citizens, without expressing any opinion as to the contents of the *Freethinker*, condemns the prosecution of that journal as a dangerous revival of laws framed in a spirit of persecution, and now out of harmony with enlightened opinion, and resolves to take all lawful means to obtain a repeal of the statutes relating to blasphemy; that considering the severity of the sentences on Messrs. Foote, Ramsey, and Kemp, the circumstances attending their trial, and the invidious character of prosecutions for blasphemy, this meeting approves of a memorial being presented to the Home Secretary praying for a remission of the sentence."

HOME MUSIC.

BY THOMAS FOSTER.

MANY regard with unmixed satisfaction the development of musical taste during the last quarter of a century or so in this country. Our music-loving public now attend concerts and hearken to music which, twenty or thirty years ago, would have had few attractions for them, and would have attracted few hearers. Young ladies thirty years ago were content to play little beyond operatic music or the simpler kinds of classical music. Now they aim at compositions of the highest class, and speak with contempt of such simpler music as their mothers played. Men (who, by the way, are much more musical, in general, than women, though the fact is absurdly overlooked in our system of education) are smitten with the same ambition. It is a condescension for your average amateur to turn from Bach to Mozart, or even to Beethoven. He will work with lissome fingers—though not always quite so accurately as he imagines—through some composition of the great Sebastian's which only a few of the very finest musicians could interpret; and when his hearers, weary of what is really very fine music very inefficiently played, ask for something more within his powers of execution, he will in his heart revile them as having low musical tastes, and with his tongue express his contempt by asking whether they would rather have a galop, a waltz, or a polka.

I believe that the musical development to which I have referred has not been altogether beneficial. It might have been. Its purpose was excellent. If music were not, unhappily, learned and practised too often only for display, and not for love, the lessons which our amateur musicians have been able to learn, the higher music which has been rendered for them by the ablest living exponents in our public concerts, would have done a great deal of good. But unfortunately our present system causes thousands to "learn music" who have no music in their souls, and therefore are unable even to know how remote from music is their rendering of the masterpieces of our great musicians. They will sit down and play on a perfect instrument, with perfect mechanical accuracy (though this is not common), the "Moonlight Sonata," or the "Sonata Pathétique," or even a fugue of Bach's, and give less pleasure, even to those who, being really musicians, know and understand the beauty of the great masterpieces of classical music, than would be given by a girl of ten or twelve playing feelingly and truly some simply arranged air of Bellini's or Donizetti's.

The fault I have to find with the home music of our day is that though not one person in five has real musical power, and scarce one woman in ten, almost every girl is taught to play, and—whether from love of display on her own part, or on the part of her parents—every girl who is so taught continues to learn until she has attacked and (so far as fingering is concerned) has mastered the finest works (for the piano) of the great composers. The few that are really musical must go with the rest, and unless their musical talent is very marked indeed, their love of music is literally ground out of them in the constant effort to play what is beyond their powers. When they should be learning to play with expression and feeling some simple, touching melodies, they are carried on to weary practice at brilliant fantasias. When they have acquired sufficient facility of execution to deal with such pieces successfully—that is, so to master all difficulties of mere execution as to be able to play with feeling, and to bring out the composer's real meaning—they are taken on to music still more difficult, and with deeper though also higher significance. And so from lesson to lesson, always a little beyond their strength, until, when they reach the greatest development which their teachers can impart, they have passed through ten or twelve years of musical training during which they have scarcely once had an opportunity to master more than the mere physical execution—the depth and passion, the joy and pathos of the music they have worked at remaining utterly unknown to them.

If this system ruins the musical aptitude even of those who have music in their souls, what must be its natural influence on those who have little or none? Girls become players of the piano, who, if their teachers had had any sense, would early have left the piano alone—as certainly nine out of ten of our most skilful executants ought long since to have done. When "a little music" is asked for, these unmusical key-ticklers are the first to be called on to perform—an admirable word for what they do. In former times, when home music was desired, those only played who loved music and possessed musical aptitude—which means more than mere love of music, just as the power fitly to read or recite poetry means more than the mere power of appreciating it. In those days we heard much more music of the simpler sort than we do now. There were few brilliant executants. But I think our home music was sweeter and better, even in the musician's sense, than what we hear now. There are many who play with wonderful dexterity and precision very difficult music, music which is indeed very beautiful, only it requires a musician to bring out its beauty, and they are only well-practised fingerists. That many of these brilliant players have no real musical power might be readily shown if they were ready to stand the test. Set before them some simple but beautiful passage, presenting no difficulties whatever, so far as mere execution is concerned, but so full of sweetness that properly rendered it would move the heart of every hearer, bring tears to the eyes by its pathos, rouse the soul by its fire, or stir yet deeper emotion by its solemn grandeur. If they can be brought "to play such an easy piece," so unworthy of their skill, you shall be surprised to find how utterly commonplace and unmeaning the noblest composition is when played without musical feeling. You may then try another experiment. Take a very simple air indeed, not very deep, not impressive at all, but light and graceful. Ask one of these unmusical, but most skilful, pianists to play it, and you will find it utterly worthless; then (or on another day, lest you hurt anyone's feelings) ask a real musician, whose power to render the most difficult music does not interfere with his power of appreciating the beauties of simpler compositions, to play the self-same pieces. As you enjoy the graceful movements of the lighter music, and as your soul thrills responsive to the joy or pathos, the fervour or solemnity of some simple but beautiful composition, you will learn what real music is, and how far those fall short of being musicians who have mere *technique* without feeling, mere manual and digital dexterity without true musical capacity.

My subject has its serious side. The pleasures of life are not so numerous that we can well afford to lose any of them, still less those which are among the best and purest. Home music, even of the simplest sort, may be made a source of great pleasure, if music is aimed at, and not mere display of manual skill.* To the tired worker,

* It is a misfortune that so much of the music written for young players—operatic fantasias, variations on simple airs, and so forth—is written for display rather than for true musical effect—display of the composer's cleverness, as well as to give the learner opportunity to acquire and display executional dexterity. Some of the arrangements referred to exhibit the most remarkable insensi-

wearied by the worries of the day's toil, there is nothing more soothing than sweet and beautiful music, played feelingly and well. But in too many homes nothing of the sort can now be had. To ask for music, means to ask for a more or less advanced specimen of exercise-playing. The only comfort which a man can find whose day has been passed in the work of his business or profession lies in the thought that he escapes the weary hours of home practising which culminate in these achievements. But not so very long ago even the sound of "the girls practising" was not always unpleasant; for they used to play simple and beautiful pieces, nor mere musical fireworks on the one hand, or pieces beautiful indeed but utterly beyond their strength on the other. It seems to me that if the mothers, or even the grandmothers, of some of our brilliant fingerists would occasionally sit down and—even with somewhat stiffened fingers, mayhap—play some of the sweet and touching melodies (by the greatest composers, too, be it noted) which used to charm the boyhood and girlhood of folks now in middle life or "in the sere and yellow leaf," some of the more sensible of our young folks would learn to be a little ashamed of their brilliant and "icily faultless" execution of pieces whose real meaning is utterly beyond their power of interpretation.

THE CHEMISTRY OF COOKERY.

By W. Mattieu Williams.

"PLEASE, mum, the fish would break to pieces," would be the probable reply of the unscientific cook, to whom her mistress had suggested the desirability of cooking fish in accordance with the principles expounded in my last. Many kinds of fish would thus break if the popular notions of "boiling" were carried out, and the fish suddenly immersed in water that was agitated by the act of ebullition. But this difficulty vanishes when the true theory of cookery is understood and practically applied by cooking the fish from beginning to end without ever boiling the water at all.

In the case of the leg of mutton, chosen as a previous example, the plunging in boiling water and maintenance of boiling-point for a few minutes was unobjectionable, as the most effectual means of obtaining the firm coagulation of a superficial layer of albumen; but, in the case of fragile fish, this advantage can only be obtained in a minor degree by using water just below the boiling-point, for the breaking of the fish by the agitation of the boiling water does more than merely disfigure it when served; it opens outlets to the juices, and thereby depreciates the flavour, besides sacrificing some of the nutritious albumen.

To demonstrate this experimentally, take two equal slices from the same salmon, cook one according to Mrs. Beeton and other orthodox authorities by putting it into cold water, or pouring cold water over it, then heating up to the boiling-point. Cook the other slice by putting it into water nearly boiling (about 200° F.), and keeping it at about 180° to 200°, but never boiling at all. Then dish up, examine, and taste. The second will be found to have retained more of its proper salmon colour and flavour, the first will be paler and more like cod, or other white fish, owing to the exosmosis or oozing out of its characteristic juices.

I was surprised, and at first considerably puzzled, at what I saw of salmon cooking in Norway. As this fish is so abundant there (1d. per lb. would be regarded as a high price in the Tellemark), I naturally supposed that large experience, operating by natural selection, would have evolved the best method of cooking it, but found that, not only in the farmhouses of the interior, but at such hotels as the Victoria, in Christiania, the usual cookery was effected by cutting the fish into small pieces and soddening it in water in such wise that it came to table almost colourless, and with merely a faint suggestion of what we prize as the rich flavour of salmon. A few months' experience and a little reflection solved the problem. Salmon is so rich, and has so special a flavour, that when daily eaten it soon palls on the palate. Everybody has heard the old story of the clause in the indentures of the Aberdeen apprentices, binding the masters not to feed the boys on salmon more frequently than twice a week. If the story is not true it ought to be, for salmon every day would have the same effect as the daily breakfasts of boiled fat pork and dumplings on the voracious hero of another story.

By boiling out the rich oil of the salmon, the Norwegian reduces it nearly to the condition of cod-fish, concerning which I learned a curious fact from two old Doggerbank fishermen, with whom I had a long sailing cruise from the Golden Horn to the Thames. They agreed in stating that cod-fish is like bread, that they and all their mates lived upon it (and sea biscuits) day after day for months together, and never tired, while richer fish ultimately became repulsive if eaten daily. This statement was elicited by an immediate experience. We were in the Mediterranean, where the bonetta was very abundant, and every morning and evening I amused myself by spearing them from the martingale of the schooner, and so successfully that all hands (or rather mouths) were abundantly supplied with this delicious dark-fleshed, full-blooded, and high-flavoured fish. I began by making three meals a day on it, and at the end of about a week was glad to return to the ordinary ship's fare of salt junk and chickens.

This is not exactly a digression, seeing that the philosophy of the appetite is fundamental to that of cookery. A healthy, unvitiated appetite is an index to the requirements of nutrition. Other illustrations of this will be presented as we proceed.

Another important constituent of animal food is *gelatin*, or *gelatine*. It constitutes a large proportion of the whole bulk of the animal; it is, in fact, the main constituent of the animal tissues, the walls of the cells of which animals are built up being composed of gelatin. I will not here discuss the question of whether Haller's remark:—"Dimidium corporis humani gluten est," "half of the human body is gelatin," should, or should not now, as Lehmann says, "be modified to the assertion that half of the solid parts of the animal body *are convertible, by boiling with water*, into gelatin." Lehmann and others give the name of "glutin" to the component of the animal tissue as it exists there, and gelatin to it when acted upon by boiling water. Others indicate this difference by naming the first "gelatin," and the second "gelatine."

The difference upon which these distinctions are based are directly connected with my present subject, as it is just the difference between the raw and the cooked material, which, as we shall presently see, consists mainly in solubility.

Even the original or raw gelatine varies materially in this respect. There is a decidedly practical difference between the solubility of the cell-walls of a young chicken and those of an old hen. The pleasant fiction which

bility to the real musical meaning of the passages dealt with. Callcott's later compositions were especially indifferent in this last-mentioned respect, though free from the wilder tricks of some other popular composers.

describes all the pretty gelatine preparations of the table as "calf's-foot jelly," is founded on the greater solubility of the juvenile hoof, as compared to that of the adult ox or horse, or to the parings of hides about to be used by the tanner. All these produce gelatine by boiling, the calves' feet with comparatively little boiling.

Besides these differences there are decided varieties, or, I might say, species of gelatine, having slight differences of chemical composition and chemical relations. There is *Chondrin*, or cartilage gelatine, which is obtained by boiling the cartilages of the ribs, larynx, or joints for eighteen or twenty hours in water. Then there is *Fibroin*, obtained by boiling spiders' webs and the silk of silkworms or other caterpillars. These exist as a liquid inside the animal, which solidifies on exposure. The fibres of sponge contain this modification of gelatine.

Another kind is *Chitin*, which constituted the animal food of St. John the Baptist, when he fed upon locusts and wild honey. It is the basis of the bodily structure of insects; of the spiral tubes which permeate them throughout, and are so wonderfully displayed when we examine insect anatomy by aid of the microscope, also of their intestinal canal, their external skeleton, scales, hairs, &c. It similarly forms the true skeleton and bodily framework of crabs, lobsters, shrimps, and other crustacea, bearing the same relation to their shells, muscles, &c., that ordinary gelatine does to the bones and softer tissues of the vertebrata; it is "the bone of their bones, and the flesh of their flesh." It is obtainable by boiling these creatures down, but is more difficult of solution than the ordinary gelatine of beef, mutton, fish, and poultry. To this difficulty of solution in the stomach, I suspect the nightmare that follows lobster suppers.

I once had an experience of the edibility of the shells of a crustacean. When travelling, I always continue the pursuit of knowledge in restaurants by ordering anything that appears on the bill of fare that I have never heard of before, or cannot translate or pronounce. At a Neapolitan restaurant, I found "*Gambers di Mare*" on the *Carta*, which I translated "Leggy things of the sea," or sea-creepers, and ordered them accordingly. They proved to be shrimps fried in their shells, and were very delicious—like whitebait, but richer. The chitin of the shells was thus cooked to crispness, and no evil consequences followed. If reduced to locusts, I should, if possible, cook them in the same manner, and, as they have similar chemical composition, they would doubtless be equally good.

Should any epicurean reader desire to try this dish (the shrimps, I mean), he should fry them as they come from the sea, not as they are sold by the fishmonger, these being already boiled in salt water (usually in sea water) by the shrimpers who catch them, the chitin being indurated thereby.

The introduction of fried and tinned locusts as an epicurean delicacy would be a boon to suffering humanity, by supplying industrial compensation to the inhabitants of districts subject to periodical plagues of locust invasion. The idea of eating them appears repulsive *at first*, so would that of eating such creepy-crawly things as shrimps, if no adventurous hero had made the first exemplary experiment. Chitin is chitin, whether elaborated on the land or secreted in the sea. The vegetarian locust and the cicala are free from the pungent essential oils of the really unpleasant cockchafer.

INTERNATIONAL SCIENTIFIC SERIES.—NOTICE.—The New Volume in the above Series, entitled ELEMENTARY METEOROLOGY, by ROBERT H. SCOTT, Secretary to the Meteorological Council, is Now Ready, with Numerous Illustrations, crown 8vo, cloth, price 5s.

London: KEGAN PAUL, TRENCH, & CO.

THE BIRTH AND GROWTH OF MYTH.

V.

By EDWARD CLODD.

WE said that language lays bare the mental condition under which myths are formed; in other words, that speech reveals the limitations of thought. And it would be a useful corrective of theories concerning the origin of language to which many are yet wedded to show that not only terms for things material and concrete, but also for things immaterial and abstract, are of purely physical origin—that is to say, have been chosen from their analogy to something real. As an example, the several verbs whose relics survive in the substantive verb *to be* had each a distinct physical meaning. "Am," "are," "is," are derived from *as* (in Sanskrit *asu*, "life,"), meaning "to breathe" or "sit"; "was" and "were" from *vas*, "abide"; and in "be" and "been" (from *bnû*, a Sanskrit cognate with Latin *fu*, Greek *phy*, "to grow") are contained the idea of *growing*. But to follow this would take us from the main business of these papers; enough that, out of manifold combinations of a few inarticulate or unjointed sounds, the larger proportion of which were imitative, have arisen the languages of the world, from the meagre stock of words of the unlearned and the savage, to the noble and expanding vocabularies of educated men.

Passing to the facts upon which the solar theory of myths rests, the following stands foremost. The researches of scholars, notably of the German Bopp and Jacob Grimm, have shown that the languages spoken in Europe by the Keltic, Teutonic, Slavonic, Greek, and Latin races, and in Asia by the Hindus, Persian, and some lesser people, are the common descendants, under modifications through various causes, of one mother-tongue known as the Aryan (from a Sanskrit word cognate with the root *ar* to plough), a term applied in the Vedas to the dominant occupiers of the soil, the "tillers" in India, who spoke it. The above group of languages is also called the Indo-Germanic, and, with more appropriateness, as roughly defining the races included therein, the Indo-European. Of course, wherever the several branches of the old Aryan family finally settled, they mixed more or less with the aboriginal races, whom they conquered. But, making such allowances as this demands, it holds good that people to-day, so unlike in complexion, physique, colour of hair, and speech, as the Hindoo and the Icelander, the Russian and the Englishman, the Persian and the German, are the offspring of common ancestors, of whom, although no material relics survive, language remains to attest what considerable advance from primitive savagery they had made. Wave after wave of immigrants, among the earliest being the Kelt, followed one another westward, to wrestle for the fairest lands; so that when, centuries later, the veteran legions of Cæsar crossed swords with the Belgæ in this island, they fought against men remotely kin to themselves both in language and in blood.

Furthermore, the evidence which has yielded this most interesting fact also shows that the old Aryans, before they separated into tribes, each of varying dialect, had a common mythology. This, which had its source, as myth everywhere had, in man's endeavour to interpret the meaning of his surroundings, had developed into a deification of the powers of nature, and likewise become the groundwork of traditional history, as well as the source of legend, folk-lore, and folk-tale. So venerable are these last-named in their antiquity, that the nursery stories told in Iceland and in the Tyrol, in the Highlands and in the Deccan, are identical. After allowing for local colouring,

and for changes incident to the lapse of time, they are the variants of stories related to children in the Aryan fatherland at a period historically remote, and moreover are told in words which are phonetically akin. Their correspondences, often extending to minor detail, are not explained by any theory of borrowing, for no trace of intercourse between Aryans of the East and West occurs until long after the domiciling of the stories where we find them. Nor did they, with such close resemblances as appear between the German Faithful John, and the Hindu Rama, and Luxman, and between our own Cinderella, the German Aschenputtal, and the Hindu Sodrwa Bai, spring native from their respective soils. And there is just that unlikeness in certain detail which might be expected from the different positions and products of the several Aryan lands. They explain, for example, the absence from Scandinavian folk-love of creatures like the elephant, the giant ape and turtle, which figure in Brahmanic beast epic. Now, what is true of the folk-tales applies with added force to the mythologies. In the great epics of the Greeks, the Iliad and Odyssey; of the Norsemen, the Volsungs; of the Germans, the Nibelungs; of the English, King Arthur and his Round Table Knights; of the Hindus, the Ramâyanâ and Mahâbhâratâ; of the Persians, the Shâh Nâmeh; we find similarities of incident and episode which are inexplicable, except upon the theory of a common origin. So far as the names and characteristics of the heroes and heroines are concerned, their phonetic identity reveals that common origin, whilst their analysis explains their common meaning.

The key to this is the Sanskrit language. In the history of the Indo-European family of speech, it served as the starting-point, because, although not the ancestor, it is the eldest member, and has more than the others preserved its roots and suffixes in a more perfect form. And in the history of Indo-European mythology, it is in the ancient Vedic texts, chiefly the Rig-Veda, that we find the materials for comparative study, since in these venerable hymns of a Bible older than our own are preserved the earliest extant forms of Aryan myth.

The method adopted was to compare a number of the Greek names of gods and heroes of somewhat obscure meaning with names of Vedic deities whose meaning is clear. The phonetic relationship between the two sets of names, hidden as it is by the interchange of sounds, is proved by the law which governs such interchange or "permutation of consonants," known, after its discoverer, as "Grimm's law." The causes of this are not easy to ascertain, but they are referable to physical influences, as climate and conditions of life, which in the course of time bring about changes in the organs of speech—such, for example, as make *th* so difficult of pronunciation to a German, in whose language *d* takes its place, as *drei* for *three*, *durstig* for *thirsty*, *dein* for *thine*, &c. We may note tendencies to variation in children of the same household, their prattle often affording striking illustration of Grimm's law, and it is easy to see that among semi-civilised and isolated tribes, where no check upon the variations is imposed, they would tend to become fixed and give rise to new dialects. The method has been justified by its works. The familiar myth of the birth of Athênê gives a good illustration of this. She is said to have been the daughter of Zeus, and to have sprung from his forehead. Now the Greek *Zeu*, the Latin *Deus* (whence the French *Dieu* and our *deity*), the Lithuanian *diewas*, and the Sanskrit *Dyaus*, all come from an old Aryan root *div*, or *dyu*, meaning "to shine." The Sanskrit *dyu*, as a noun, means "sky" or "day," and in the Veda, *Dyaus* is the bright sky or heaven. Athênê is the Sanskrit Atanâ, one of the many Vedic names for the dawn. Thus the primitive meaning of the myth comes out; the dawn springs from the forehead of the sky; the daybreak appears rising from the East. But the Greek, in whose Pantheon Zeus had been exalted as god of gods, did not dream that to his remote ancestor that god was but the sky personified and deified; even his philosophers had traced it to the root *zeu*, "to live," and for ever lost the track.

Ouranos, or Uranus, is the Vedic Varuna, the all-surrounding heaven, from a root *var*, to veil or cover; Helen, stolen by Paris (in Sans. *Pani*, "the deceiver") from Sparta, is the Vedic Saramâ, the dawn, from the root, *sar*, to creep; the Charites, or Graces, are the Harits, or bright coursers of the sun, from *ghar*, to shine, whence the idea of splendour in its transfer to the fair women who attended Aphrodite; the Erinyes, or Furies, are the Saranyû, or dawn, which brings evil deeds to light. Hence, they who did this became regarded as avengers, whose fury pursued the wrong-doer.

These comparisons might be followed throughout the whole range of classic as well as of Teutonic and other epic with the like result. They apply equally to the mythical phrases in which the adventures and general career of the gods and heroes are narrated, for the details of which my readers are referred to such works as Sir G. W. Cox's "Mythology of the Aryan Nations" and "Tales of Ancient Greece." That these majestic epics have one and all their germs in the phenomena of the natural world and the course of the day and year, seems to me demonstrated. But when the solar mythologists contend that "there is absolutely nothing left for further analysis in the stories," that every incident has its birth in the journey of the sun, the death of the dawn, the theft of the twilight by the powers of darkness, we rebel against so sweeping an application of the theory. They are nature-myths, but they are much more than that; the impetus that has shaped them as we now know them came from other forces than clouds and storms, and it is with these that our next paper must be concerned.

Erratum in last paper, p. 130, l. 14. For "sensations of a myth," read "sensations of a moth."—[! R. P.]

THE GREAT COMET OF 1882.—III.

By Professor C. A. Young.

(*Continued from page* 149.)

THE spectroscopic observations have been very interesting. On Sept. 18 the French physicist, Thollon, was an independent discoverer of the comet, coming upon it accidentally in sweeping around the sun. His spectroscopic apparatus consists of a so-called siderostat, the mirror of which throws the rays from the object to be examined upon the lens of a horizontal telescope 9½ in. in diameter, and about 20 ft. long. At the focus of this telescope in a darkened room is placed a spectroscope, and of course this may be of any form and power best suited to the occasion. In the present case he used an instrument with a single prism of high dispersive power. The most marked feature of the spectrum was the presence of the lines of sodium in the spectrum of the nucleus. They were very bright, and were displaced toward the red by an amount equal to about one-fourth of the interval between them, thus indicating that the comet was rapidly receding from the earth. A very narrow, bright, continuous spectrum

was also shown by the nucleus. In this the dark lines of Fraunhofer were not conspicuous, if visible at all, showing that the principal brilliancy of the comet was not reflected sunlight. The usual carbon bands of the cometary spectrum were not visible through the sky illumination, and no other bright lines except those of sodium were seen by Thollon. On the 22nd the comet's spectrum was observed in the early morning just before sunrise, by Ricco, of Palermo. He reports his observation thus:—"The spectrum was formed of the narrow continuous spectrum of the nucleus, traversed by a large and strong line of sodium (D); by enlarging the slit I saw a globular, monochromatic image of the nucleus and coma. Besides the line of sodium, many others were present, but, my spectroscope not having a micrometer, I did not determine them. I observed a band in the red, a line in the yellow near and after D, two others in the green, and an enlargement of the continuous spectrum in the green and blue." It is exceedingly unfortunate that the position of these lines could not have been determined, at least approximately. No one can predict when such an opportunity will occur again.

The weather in this part of the country was abominable up to November. I attempted to get spectroscopic observations on Sept. 20, but was foiled by clouds, and have since succeeded only on October 2, 4, 10, 15, and 24. On the first of these dates the sodium-lines were still easily visible, though not conspicuous. The carbon bands were magnificent, especially the brightest one (in the green), in which could be clearly seen the three fine lines observed in the spectrum of Coggia's comet. The band in the violet was very faint. The nucleus gave a strong continuous spectrum, on which the carbon bands were superposed; and in the tail the proportion of white light (continuous spectrum) to carbon light appeared to be about the same as in the nucleus. The bands could be followed far out into the tail by widening the slit, but were lost before the continuous spectrum quite vanished. No dark lines were made out. On the 4th the results were the same, except that the sodium-lines were very hard to see, and they disappeared entirely before the next date. The later observations added nothing more. It is much to be hoped that, when the different results of all observers come to be collected and published, something will be found to supply what is so unfortunately wanting in Ricco's most interesting but incomplete observation—*hiatus valde deflendus.*

The highest interest of the present comet lies in its orbit, however, its relation to preceding comets, and its possible speedy destruction by the sun. Almost as soon as it appeared, Professor Boss, in America, and Hind, in England, proposed the hypothesis that it is identical with the great comet of 1880, the period of the latter comet having been shortened by some resistance. If so, this comet will be back again in a few months, and before long must fall upon the sun. They have weighty arguments on their side, but on the whole a different conclusion is more probable.

(*To be continued.*)

ASBESTOS rope is described amongst other articles in a new catalogue published by the United Asbestos Company. The strength seems to be about one-fourth that of ordinary hemp rope of the same diameter. Rope 1·5 in. diameter has a breaking strength of one ton, and 20 ft. of it weighs 13¼ lb. The breaking strength of the rope 0·6875 in. diameter—$\frac{11}{16}$—is 0·2 tons, or 4 cwt., a 20 ft. length weighing 3¼ lb. The rope is made especially for fire-escapes purposes, for theatres, fire brigades, and for ready means of escape from houses and public buildings, the advantage being that the rope will not break and drop its burden if a flame bears upon it. It is made like ordinary rope, but spun from Italian Asbestos thread.

HOW TO USE OUR EYES.—III.

BY JOHN BROWNING, F.R.A.S.

(*Continued from p.* 150.)

COMPLEMENTARY COLOURS.

WHEN a coloured object is looked at for some time, if the eye be directed to another object which is grey or colourless, this object will appear to be strongly coloured, just the opposite colour to that of the first object the eye had been regarding.

By the expression the opposite colour, I mean the complementary colour—that is, the colour which added to the first colour would produce white.

Blue causes the grey portion of the object to appear yellow, while yellow causes the grey portion to look blue. Red causes the grey to appear green, while green makes the grey look red.

It must not be supposed that if green paint be mixed with red, or orange paint with blue, that white will be the result.

Owing to the impurity in an optical sense of all our colours, we obtain only dark greys by such mixtures. But if you reflect the complementary colours from the *spectrum*, in which the colour is optically pure, one on the other, you can make colours that will be very different to those you will obtain from the mixture of pigments, and by using carefully-selected pieces of coloured glass in two lanterns, colours will be produced very different to those obtained by the mixture of pigments.

The colours of stained glass are much purer and brighter than any of our pigments.

There are three ways by which colours can be mixed. 1st, by grinding up the colours together. 2nd, by laying coats of colour over each other. 3rd, by making narrow lines or dots of the colours close to each other. The two last methods are but little known or used, yet they are the methods which give the most beautiful as well as the most scientific results.

On a *revolving* wheel place a disc covered with black and yellow paint mixed together. The disc appears green. On another disc let a portion of the surface be coloured yellow and a portion black. On rotating this disc the colour will be not dark green, but dark yellow. Mix blue and red, and then blue and yellow, first by mixing the paints, and then by colouring a portion of each disc, and note the different result obtained by the two methods.

The diagrams invented by Mr. Gorham, the inventor of the coloured top, will show the appearances I have just described. You will see the grey portion in the blue disc appear yellow, the grey portion of the red disc appear green, and the grey portion of the green disc appear a reddish chocolate.

It is from want of knowledge of this fact that many artists over-colour their pictures. They make their shadows too blue in what they would call a warm picture—that is, a picture of a red or orange or yellow tone of colour, and the shadows in a cold or bluish picture they make too red. This in another direction proves the necessity of learning to see. Such artists require to be shown that perfectly colourless shadows in a bluish picture will look red, and equally colourless shadows in a reddish picture will appear blue.

Although we cannot with our unassisted eyes tell how pure or impure colours or paints are, we can detect their impurities by means of a spectroscope.

There are many coloured liquids and glasses which look to us almost exactly alike. Now let us see how they look when we analyse or cross-question them by sending the

colour through a spectroscope. Take, for instance, blood, cochineal, permanganate of potash, and chlorophyll. By using a miniature spectroscope, blood may be distinguished from other liquids similar in colour, and an idea may be formed whether the blood is fresh. This has been of use in examining the clothes of a suspected murderer, and has led to detection. A quantity of dried blood that would lie on a pin's head could be analysed by this process.

One instance in which this method was applied seemed to me of great interest.

Some years since, a dreadful murder was committed in Cannon-street, in the City. The housekeeper in charge of some offices was killed in the passage of the house about eight o'clock in the evening. Shortly after, a man, a distant relative of the murdered woman, was arrested on suspicion. On inspecting his clothes, a number of small, dark red stains were found upon them. These were scraped off the cloth by an eminent chemist. This chemist brought half the amount of the dried substance to me. Half of this minute quantity I sent to a distinguished scientific friend, and half I experimented on with the spectroscope.

The amount being so small, we could not make a sufficient number of experiments with it to enable us to say positively what substance it was, but both my friend and myself came to the conclusion that it was certainly *not blood*.

When the trial came on, the man proved an *alibi*, and explained that the dark spots on his clothes were red shellac varnish, which he had got on him at a hat-maker's, who used it for stiffening the shapes of his hats.*

(*To be continued.*)

THE NEW SKIRT.

By a Lady.

I HOPE you do not consider the question of Stays and Tight Lacing exhausted. Having read with interest everything on this subject that has appeared in KNOWLEDGE, it seemed to me that it would be an easy experiment, and might be a useful one, to try the effect of leaving off stays, and using the divided skirt. The results of my experience may, perhaps, be of interest to your readers.

I must confess that I left off stays with some misgiving, having the idea that the support they give is absolutely essential, and that, as I had become thoroughly accustomed to them (as is the case with most), I should not be able to hold myself upright or walk well without their aid. I may mention that my waist measurement with stays was 24 in., my age is 27, height 5 ft. 4 in., chest measurement 39 in. I was married when I was 18. I have had four children, the last of whom was born ten months before I left off stays. It will be admitted that the experiment was made under very fair conditions for testing it.

My first experience was simply delight at my new freedom. I could bend at will, take a long breath without discomfort, sing songs I had been unable to sing for years, and walk much further with much less fatigue. I was surprised to find how little I missed the support my stays had given me. But I must admit I thought I should very soon have to wear them again; for my skirts tired my waist and hips when I was standing or walking. I became less tired than before, speaking generally, but more uncomfortable round the waist; also the skirts dragged the dress out of shape.

So soon, however, as I tried the divided skirt, all these difficulties were removed. I had felt great reluctance in assuming this new kind of dress, as I had thought it was something quite noticeable and conspicuous. The pictures in *Punch*, in particular, must have been drawn by people who had never seen the skirt. They give an entirely wrong idea of it. In fact, it is not strictly speaking a dress; that is, it forms no part of the visible dress. It is neither more nor less than a pair of such trousers as little girls used to wear forty or fifty years ago; only, instead of the frilled edges showing below the dress, they are completely hidden—unless the wearer should prefer to have the dress unusually short. They are trimmed with deep plaiting, and in walking, if visible at all, which is quite optional, appear like a petticoat. They are not suspended from the waist, but from a calico band—to use this word for want of a better, but in reality this support is fitted to the figure round the hips, and the divided skirt is buttoned to it.

I should think that no one who had tried the new dress would ever resume her heavy petticoats and stays. The gain when I had left off the stays was great; but when the petticoats were left off, the gain was very much greater. The sense of lightness and freedom was truly enjoyable. The warmth of the divided skirt is equal to that of at least three petticoats. There is, indeed, no comparison between them as regards protection from cold. I have tried them for walking, running, dancing, and tricycling, and have as much comfort again in all these exercises as I had before; or rather, discomfort is replaced by perfect comfort.

It may, perhaps, be supposed that the change has caused my waist to grow larger. But this is not the case. On the contrary, my waist now measures two inches less. Dresses which were made before the change are now quite loose, and have had to be refitted. My dressmaker, however, finds it easier to fit me without the stays, and dresses made since the change fit much better and look much nicer.

I do not suppose that ladies who are so unfortunate as to have no waist would care to leave off stays, for the general prejudice has been, and is, in favour of some slight diminution of circumference at the waist. But that need not prevent them from trying the divided skirt; indeed, I should imagine that it would be possible, though I do not say it would be wise, to lace tighter when wearing the divided skirt than when, in addition to the bad effects of undue compression, the weight of several heavy petticoats is dragging the body down. The dress can be made as fashionably as the lady pleases—in point of fact, I am sure no one would know that a lady, whether seen in the drawing-room or in the ball-room, or taking exercise, was a follower of the new fashion except by the improvement of her figure, and the greater grace and lightness of her movements.

[I have received also a contribution on the other side, for which I do not find space, for the simple reason that it proves nothing. A lady states that, being interested in the question whether the figure can be trained without injury, she bought corsets, by means of which she gradually compressed her waist, till the circumference was reduced from 29 in. to 20 in., and though at first uncomfortable, she got at last even to like the feeling of support given by the tightly-laced corsets; yet, not caring to be a tight-lacer, she soon after gave up wearing these tight stays. This proves how much that admirable specimen of

* For further information on the spectroscope, see "The Spectroscope and its Work," by R. A. Proctor; a truly marvellous little book in the amount of information it contains, being equally popular and accurate.

Nature's work—the human trunk—can bear without giving way; but nothing more. It suggests also that, whatever the lady may think she remembers, she was more comfortable when less tightly laced.—R. P.]

PLEASANT HOURS WITH THE MICROSCOPE.

By HENRY J. SLACK, F.G.S., F.R.M.S.

AN interesting train of thought may be suggested to the microscopist who will pay some attention to the tool and implement-making processes which occur in many of the lower organisms, and which result in objects wonderfully like the productions of human invention and skill. The objects alluded to are called tools and implements for want of more appropriate terms. They are exactly like what men so designate, although their uses in the economy of the creatures forming them are different. A good slide or two of sponge spicules, obtainable from any vendor of microscopic preparations, afford excellent illustrations. Sponges consist of a very soft animal matter, supported, except in one family, by a horny, flinty, or chalky framework, as the case may be. The two last especially are strengthened by spicules of various shapes, and also provided with spicules of defence, which make them inconvenient objects for their enemies to bite. That a soft animal should be able to take from the water in which it dwells calcareous or silicious matter, and deposit it in convenient forms, is not in itself an unusual or very striking circumstance; but we are astonished when we find little models of hooks, spears, tridents, grappling-irons, caltrops, and many other tool and implement sorts of things.

Amongst the most curious are the fish-hook spicules of *Hymedesmia Johnsonii*. Each shank carries two hooks—one at each end—and they project at right angles to each other, or near it. The hook part has an extremely sharp internal knife edge, a very acute point, and at the base of the blade a little notch which acts as a barb. The variety to be found in different genera of sponges is considerable, and it is marvellous that organic processes of growths should in many instances prefigure human inventions. In the sponge family they cannot properly be called either tools or implements; they are strange simalacra, and though each form must have special reference to the life-processes of the creature, they have not the same special adaptation to its habits that we find in the apparatus with which insects are furnished. We can scarcely imagine that a sponge whose defensive spicules are like caltrops can be better or worse provided for the battle of life than one with fish-hooks; but when we come to the tools and implements of insects, we see a close adaptation to peculiar wants.

The mouths of insects exhibit a wonderful variety of modifications, and in many cases, if the early races of men had been able to see them, they might have found patterns of the most useful tools. The subject of these mouths is too large and too important to be spoilt by a casual notice; but it may be said with Haeckel, "the heads of flies universally possess, beside the eyes, a pair of articulated feelers, or antennæ, and also three jaws on each side of the mouth. These three pairs of jaws, although they have arisen in all flies from the same original basis, become changed by different kinds of adaptation to very varied and remarkable forms in the various orders." Chewing, sucking, biting, and licking, are the functions which the mouths of different insects are modified to perform. The mouth organs, as prepared in the slides generally sold, are all flattened and squeezed together in Canada balsam, and in that condition are far less instructive and intelligible than if mounted in fluid, or examined in the living creature, or in some cases—large flies, bees, &c.—simply dried after the several parts have been opened out by a needle. As specimens of tool-provided insects, the student may take a common flea (*pulex irritans*), any female gnat, and one of the breeze flies—bluebottle-like flies—common in summer, with splendid green and bronze eyes, and torments to horses, cattle, and men. Many other insects might be named, but these will make a good beginning. The head of the creature to be examined should be carefully removed with a needle mounted in a wooden handle. That of the flea is well shown in thin Canada balsam. The others should be mounted entire in couples, one showing the top side, and the other the under side. The flea's head can be best seen as a transparent object in balsam, the others as opaque ones. The flea has to cut through the skin of the animals it feeds upon, and then suck their blood. Very similar is the performance of the breeze fly, but his tools are larger and stronger. The human flea, which differs more or less from some twenty-five other fleas, has two exquisitely-made saws, with double rows of teeth, a construction used by men when they wish to cut green wood, or other clogging substances. They would be reckoned very scientific tools if made by man. The breeze fly, besides his sucking apparatus, has knives like some used in surgical operations; the female gnat operates with beautifully-shaped lancets, the stings of bees and wasps work in a protecting channel analogous to the tube of the surgeon's trocar. In many insects the tool formation is exhibited at the end of the abdomen as saws and ovipositors, often closely like human inventions.

In the sponges, the tool-like things are organised membranes, infiltrated with the mineral matter. In insects, the strengthening material of the tools is chitin, the substance which forms their external skeleton, and which exists in various degrees of hardness. Its composition is highly complicated, the formula, according to Schmidt, being C_{12} H_{28} N_2 O_{11}; that is, carbon, hydrogen, nitrogen, and oxygen, in those proportions of their several equivalents.

From the tool-like formations of the sponges, we learn that their life processes are able to arrange matter in shapes that might be called organic inventions, though unconscious and automatic. If the protoplasm of sponges can do these things, we cannot be surprised to find the protoplasm of insects directed, at certain points, to similar labours, and, lastly, to find the human brain conceiving forms like those which the organic forces, operating in lower creatures, have produced, and we may wonder whether there is any subtle relation between the two.

Buyers of microscopes very often—probably, most often—get tired of the instrument because though it shows pretty and curious things, they have no train of associations with them. As soon as objects are contemplated in the light of an artistic or scientific conception, their interest is permanent and always on the increase. No attempt has or will be made in these papers merely to describe what popular and accessible books contain, but it is hoped they may excite thinking, and then observation will meet with its reward.

THE SUNDAY SOCIETY.—The Grosvenor Gallery was open to the members of the Sunday Society on Sunday last, each member having the privilege of introducing a friend. The Gallery was open from six o'clock till half-past eight, and during that time 720 persons passed through the turnstiles. Mr. Evans Williams, M.P., Professor Corfield, Mr. Rutherford, and Mr. Mark Judge were present during the evening.

XUM

Reviews.

CLOCKS AND WATCHES.*

By Richard A. Proctor.

EVERYONE ought to know something about clocks and watches, but especially about clocks. There is excellent exercise as well for the moral as the mental qualities in taking to pieces, cleaning, and putting together again, a good old English clock. You make mistakes the first two or three times, of course, and you find all sorts of unexpected difficulties, especially with the escapement. Your first mistakes are, of course, rather bad ones. Perhaps at the beginning you omit to check the train before freeing the pallets from the escapement wheel, and the spring drives the wheels round with a whirr at mischievous speed; or, after cleaning the works and putting them together successfully, you perhaps lubricate them with linseed oil (an experience of our boyhood), and get a very cloggy clock indeed. Or something goes wrong with the hand-carrying wheels; or the escapement wheel obstinately refuses to work nicely on the pallets. If it is a striking clock, you are still more apt to make mistakes, whether it is on the rack-and-snail or striking-plate system. But *tout vient enfin à qui sçait attendre.* The whole working system of the clock is, before long, mastered, and a very pretty mechanism it is found to be. I am almost disposed to think that the average boy, even if he belong to the unlucky class of those who have no particular business to do in later life, gains more by mastering a clever piece of mechanism than by learning the correct rendering of a Latin ode; though I wish no more to run down Latin lore (among the pleasantest studies we have) than to advance the study of machinery as the only fit pursuit for boys and men. Only I would have everyone who possesses a clock or watch to know something of its ingenious mechanism.

Sir Edmund Beckett's "Rudimentary Treatise on Clocks and Watches," though really intended for those who take a more special interest in horology than most of us have time to cultivate, will be found full of interesting reading by thousands who would probably make a rare mess of even a Dutch Wag o' the Wall, if they tried to clean or mend one. It teaches the principles of horology which everyone should understand, and gives so much practical information about clockmaking as is wanted by clockmakers and amateurs wishing to make or superintend clocks of superior character. The book should be widely read by clock-sellers. Many who sell the commoner sort of clocks, often know much less than they ought to know even about such clocks as they deal in. But the ignorance which formerly prevailed among those who claimed to be clockmakers, can only be rightly estimated by a study of such a work as this, from which we learn what can be done in the way of exact time-measurement, and how little some of the clockmakers of less than half a century ago knew about the requirements for such success as has since been achieved.

The treatise is so widely known (this is practically the ninth edition, though nominally the seventh, and each edition contained 3,000 copies), that it need only be noted of the present edition that it contains more new matter and alterations than any since the fourth.

Like everything Sir Edmund Beckett has ever written, this work is full of interest and full of life and character. One can hardly read a single page without recognising the personality of the writer.

The attack on the metric system (pp. 40, 41) is a fine example of Sir Edmund's style: "Doctrinaires may cram penny-school girls with French mètres, and centimètres, and kilograms; but our yard grew and will remain as the natural standard of length until the stature of the human race alters. . . . Yet there are people who want to force on all the world the absurd, inconvenient, and useless mètre, invented by a nation whose language is declining all over the world; while the English language, with that standard of measures which every man carries in his arms, his legs, and in his head, is spreading over all the world, so that it will soon be the only universal language to be found everywhere, if it is not so already." Every sentence tells like a well-weighted sledge-hammer swayed by a strong arm.

Illustrations of stupidity, such as Herbert Spencer has tellingly used, are here to be found in abundance. Sir Edmund mentions a specification for a public clock including this remarkable stipulation, — the pendulum "must vibrate two seconds, but be as long as the room admits of." The same specification stipulated for a *dead* escapement—as completely out of date for superior clocks as De Vick's balance-wheel escapement. A deputation from a considerable town, negotiating in London for a first-rate town-hall clock, engaged to pay a swindling firm more than would have paid for the best possible clock, for one warranted to keep time within five minutes a week, where five seconds would only have been a fair variation.

Sir Edmund Beckett calls attention to the absurd way in which the figures on clock-dials are made, pointing out that, in reality, the Roman numerals are not wanted at all, but simply clear marks dividing the dial into twelve parts. I have seen clock faces so cleverly arranged with a series of radiating streaks, of the same colour and shape as the body of the hands, that, though I can read a watch face at the farther end of a long room, I had to get close to the clock (which was on the mantelpiece), and to peer hard at, it before I could distinguish the hands and learn the time.

The whole story of the Westminster Clock and Bell should be studied by those who wish to know of what blunders and of what negligence officialism is capable, blunders and negligence very costly in this case to the nation, — for which the officials after their nature (which is simply average human nature put in a position of trust for which it is unfit), cared nothing, as the nation and not they would have to pay. Luckily, the blundering selfishness of officialism ended by giving Sir Edmund Beckett legal control where he had only been brought into the business to save an official from trouble; and as he was really interested in getting a good clock made, whereas the officials did not care two straws whether the clock was good or bad, he naturally was a thorn in their side. Mr. W. Cowper Temple, who had been made First Commissioner of Works by his stepfather, Lord Palmerston, was exuberantly joyful when the man to whom the nation really owes the clock had ceased to have control over it. It was handed over to Sir George Airy, who amused himself by devising a new arrangement to replace the great check-spring of the striking part: a smash naturally resulted (since Airy's knowledge of large clocks was purely theoretical); "and then the old spring was quietly replaced, and is there now, and there have been no more such experiments." The story of the bells is equally instructive. As to expense, the bells cost less than £6,000, and the clock, with the hands originally provided, cost £4,080, or

* "A Rudimentary Treatise on Clocks and Watches and Bells." By Sir Edmund Beckett, Bart., author of "Astronomy Without Mathematics." Seventh edition. Crosby, Lockwood, & Co., London.

£10,080 in all, including £750 for recasting Big Ben. Sir C. Barry's iron frame cost £6,600, and his hands and dials alone cost £5,334, or £11,934 for the architect's appendages to the clock and bells. The clock tower is not quite so hideous as the Victoria Tower, but that is all that can be said of it.

THE ELEMENTS OF WEATHER KNOWLEDGE.*

THE Director of the Meteorological Office may not be able to forecast the weather of the British Isles altogether successfully (for which, however, very sufficient reasons can be given), but he has written a capital work on Elementary Meteorology. The book before us is one of the best proportioned and most satisfactory handbooks of meteorology we have yet seen. There is scarcely any matter of interest connected with the subject which is not adequately treated here, while, as might be expected from Mr. Scott's position, the different departments are brought close up to date, a most important matter in such a subject as meteorology, undergoing constant change in details, though its general principles remain little changed from century to century. Nay, as Mr. Scott points out, the Book of Job, probably one of the most ancient of the works included in that little library of books called the Bible, "contains some sound meteorological knowledge," rather elementary, but "as true now as it was some three thousand years ago." And if our knowledge is in part so old, so also is our ignorance. Mr. Scott is obliged to admit in the case of the British Isles what was said of old in Palestine, "the wind bloweth where it listeth, and we cannot tell whence it cometh nor whither it goeth"—or, as he puts it, "Situated as the British Isles are with an ocean to the westward, we in London can never get many hours' notice of a change." On the other hand, at the Central Office in the United States, reports can be collected from an extensive area, and the changes, as they come on, can be watched at head-quarters to an extent which is quite impossible at this side of the Atlantic.

In the present work, therefore, the study of weather is only dealt with in a passing way, while the study of climate claims much closer attention and receives much fuller treatment. Cosmical meteorology is not considered at all, except in an appendix on the imagined influence of sun-spots on the weather. It is painful to note, by the way, that in dealing with this matter our author is by no means so enthusiastic as the advocates of sun-spottery would desire—nay, if it were not incredible that anyone could poke fun at that dignified body, it would almost seem as if that were what Mr. Scott meant in the following passage :—

> "Inasmuch as various investigations arrive at contradictory conclusions as to the nature of the connection between 'weather phenomena, as well as events depending on them,' and those of sun-spot frequency; one class holding that sun-spot frequency accompanies a high, while the other asserts that it is associated with a low temperature, it can scarcely be said that the close connection between solar and terrestrial phenomena is capable of accurate demonstration."

Could anything much less encouraging be said even of the follies of astro-meteorology? to which sun-spottery (whose most enthusiastic advocates are not so foolish as they seem) in reality gave birth.

We would especially recommend to our readers' attention the chapters on Temperature (III.), on Radiation (IV.), Dew, Fog, Mist, and Cloud (VII.), Rain, Snow, and Hail (VIII.), and Electrical Phenomena (X.), in Part I.; and the whole of Part II., which deals with the Distribution of Temperature and Pressure, the Prevailing Winds, Ocean Currents and Sea Temperature, the Distribution of Rain, Climate, Weather, and Storms.

The maps at the end of the book are excellent, and, though necessarily on rather a small scale, the scale suits the character and purpose of the treatise. These maps include the isothermal lines for January, July, and the whole year; the difference between the January and July temperatures and the mean temperatures for the whole world, Maps IV. and V.; the mean atmospheric pressure and prevailing winds for January and July, Maps VI. and VII.; the current-chart of the globe for the year (reduced from Maury), Map. VIII.; isothermal lines for sea-surface temperature (mean) in February and August, Maps IX. and X.; and, lastly, lines showing regions of equal annual range of temperature.

The following points have suggested themselves to us in the reading of this excellent little book (it is considerably larger, by the way, than most of the volumes of the International Series, though no higher in price). At page 41, the word "homonymous" seems an undesirable addition to our already over-long list of sesquipedal words; but these words should at least be correct, and we approve of our author's suggestion that the incorrect "atmometry" should be replaced by the correct form "atmidometry" (the blunder of the astronomical "chromosphere" for "chromatosphere," already a standing jest, needs to be matched, however, by a meteorological blunder). The explanation of *verglas* is rather misleading, as the moisture of damp air deposited in solid form produces snow crystals, not true glass-ice, which often so closely resembles glass in transparency as to be invisible from the usual height of the eye above the ground, as some (including the present writer) have found to their cost, whereas a deposit of ice crystals is very obvious to the sight. No reference is made to the determination of higher cloud levels. Our author gives a very commonplace, but probably correct, explanation of the hailstones as large as elephants, reported from India, as probably due to the collection of hailstones in large holes, and many becoming there welded into a single mass. In the figure at p. 162, the letters A, B, referred to in the text, are not shown. At p. 174, Mr. Scott points out correctly the absurdity of supposing that the eye can determine which way a lightning-flash travels. There is a very interesting account at p. 182 of the "inductive action of thunderstorms" (to use rather inexact verbiage).

It occurs to us to notice, lastly, what we cannot sufficiently admire,—the combined courage and energy which enabled a single writer (we infer from the style) to review in a couple of columns in the *Times* all the International Series thus far published—more than forty volumes. A man should be a giant in intellect—or else possess a perfectly microscopic modicum of modesty (to say nothing of conscientiousness)—to pass in review, and pronounce judgment on, forty-five works, including treatises by such men as Tyndall, Herbert Spencer, Maudsley, J. W. Draper, Bain, Quatrefages, Huxley, Young, Sheldon Amos, Romanes, and Lubbock—dismissing the series at the average rate of fifty words for each.

* "Elementary Meteorology." By Robert H. Scott, author of "Weather Charts and Storm Warnings." With numerous illustrations. (Kegan Paul & Co., London.)

THE arc lamps now illuminating the Oxford Union Society are, in consequence of their flickering light, to be replaced by 100 incandescent lamps.

THE FACE OF THE SKY.

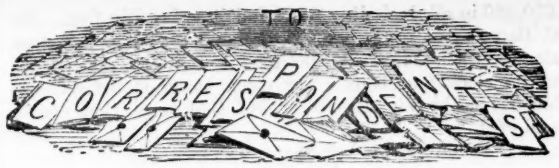
From March 16 to March 30.

By F.R.A.S.

THE sun may be watched for spots and faculæ, but they are neither so large nor so frequent as they were a few months since. The Zodiacal light should be looked for after sunset on every clear evening. The aspect of the night sky may be determined, and the constellations now visible identified from Map III. of "The Stars in Their Seasons." Neither Mercury, Venus, Mars, nor Neptune are availably placed for the observer. Jupiter is still the most conspicuous object in the night sky, but he sets soon after 2 a.m. now. He will be found above ζ Tauri. On the night of the 20th, the student should look out for the transit of Satellite III., as it has on previous occasions been seen to change from a bright to a dark spot on Jupiter's face. It will enter on his following limb at 10 h. 3 m. p.m. Subsequently Satellite II. will be occulted at 11 h. 4 m., and the transit of I. begin at 12 h. 20 m. On the 21st, Satellite II. will be occulted at 9 h. 35 m. The 22nd is a night prolific in Jovian phenomena. The ingress of the shadow of Satellite I. will occur at 8 h. 6 m., and that of the shadow of II. at 8 h. 41 m. At 8 h. 54 m., Satellite II. itself will pass off the planet's face, as will Satellite I. at 9 h. 5 m. Its shadow will follow it at 10 h. 23 m., and lastly the shadow of Satellite II. will leave Jupiter's disc at 11 h. 28 m. On the 23rd Satellite I. will reappear from eclipse at 7 h. 36 m. 34 s. p.m. Satellite III. will reappear from eclipse at 8 h. 2 m. 35 s. in the evening of the 24th. On the 28th Sat. I. will be occulted by the planet at 11 h. 32 m. The night of the 29th will be another rich one for the young observer of Jovian phenomena. Sat. I. will begin its transit at 8 h. 45 m.; as will Satellite II. four minutes later. The shadow of Sat. I. will enter on to the planet at 10 h. 2 m.; the Satellite casting it passing off at 11 h. 2 m. At 11 h. 19 m. the shadow of Satellite II. will leave Jupiter's disc; as will the Satellite itself at 11 h. 35 m. The egress of the shadow of Satellite I. will happen at 12 h. 19 m., but Jupiter will be very close to the horizon. Finally, on the night of the 30th Satellite I. will reappear from eclipse at 9 h. 32 m. 20 s. Saturn is very rapidly approaching the west now, but may still be observed an hour or two after sunset. He is situated to the S.E. of δ Arietis. If the reader will refer to Map III. of "The Stars in Their Seasons" (spoken of above), he will find a small star marked τ in the constellation Leo; a little to the left of this in the sky is a 6th Magnitude one, called 89 Leonis, and a very little above this last-named star lies Uranus, whose pale blue planetary disc in the telescope will reveal him at once.

The Moon is 7·3 days old at noon to-day, 8·3 days old at the same hour to-morrow, and so on until the 30th, when she is obviously 21·3 days old. During the next twenty-four hours she passes from Leo into Virgo, in which constellation she remains during the whole of the 17th and 18th, travelling into Libra on the 19th. She is in Libra on the 20th, and a good deal of the 21st, but moves into the confines of Scorpio towards the end of that day. Then she crosses the south-west part of Ophiuchus on the 22nd, moving out of Ophiuchus into Libra on the 23rd. She occupies the 24th in crossing Sagittarius, where she remains on the 25th, leaving it, to enter Capricornus, on the 26th. She passes into the confines of Aquarius on the 27th, occupies the 28th in crossing that constellation, enters Pisces on the 29th, and is there during the whole of the 30th. Four occultations of stars by the Moon occur at tolerably convenient hours during one specified period. On March 20th the 6th Mag. Star, 14 Sextantis, will disappear at the Moon's dark limb at 12.3 p.m., at an angle of 88° from her vertex, and reappear at her bright limb at 1 h. 17 m. the next morning. On the 21st 36 Sextantis will disappear at the Moon's dark limb at 6 h. 37 m. p.m., at an angle of 34° from her vertex, reappearing at her bright limb at 7 h. 48 m. p.m., at an angle of 215°. 50 Virginis will be occulted by the bright limb 38 minutes after midnight on the 24th, at an angle of 91° from the Moon's vertex. Both these stars are of the 6th Magnitude. ψ Ophiuchi, a 5th Magnitude star, will disappear at the bright limb at midnight on the 28th, at an angle of 87° from the vertex of the Moon, to reappear 54 minutes later from behind her dark limb at an angle of 190°. We do not give the times of reappearance, &c., when the phenomena occur after 1 a.m.

THE latest development of New Zealand cultivation is known as liquorice-farming, and we hear that many colonists are giving much attention to the subject. This plant, the *glycyrrhiza* (derived from two Greek words, signifying *sweet root*), was well known to the ancients as a medicine; and ever since the days of Queen Elizabeth it has been extensively grown in England, especially about Pontefract.—P. R.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

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No communications are answered by post, even though stamped and directed envelope be enclosed.

ON THE FORMATION OF COMET'S TAILS.

[750]—I remember, on receiving Mr. A. S. Davis's paper, feeling very pleased to find that any one was paying attention to the subject of repulsion due to evaporation, and in writing to thank Mr. Davis for his courtesy in sending me a separate copy of his communication to the *Philosophical Magazine*, I have no doubt that I complimented him on his numerical results very much in the language he has described; but I cannot admit that from the date of the publication of his paper Mr. Davis obtained anything like a prescriptive right to discuss "the adequacy of the force of evaporation to produce the repulsion observed" in comet's tails. The formula which I made use of in my paper in Knowledge of Feb. 16th, for expressing the relation between the velocity of the molecules of hydrogen and the temperature of the gas, is a direct consequence of the kinetic theory of gases, and has been used by very many persons besides Mr. Davis and myself, long before the date of Mr. Davis's paper, or of my communication to the Astronomical Society. With the exception of the use of this formula, our methods of treating the subject and our theories differ very materially.

Mr. Davis supposes the force of repulsion to be due to the evaporation of solid matter, while I, having a difficulty in conceiving of the precipitation and subsequent evaporation of the same substance in the neighbourhood of a comet's nucleus, have been driven to assume that a mist of solid or liquid particles is precipitated by the cold of space, and the particles are then acted upon by freely moving molecules of other substances which still remain in the gaseous state. Though one can conceive of the heat of the sun producing evaporation from the sunward side of a particle, it is difficult to conceive that the heat radiated from the nucleus would be sufficient (especially in the case of comets which exhibit tails when far outside the orbit of the earth) to give rise to energetic evaporation from the face of the particle turned towards the nucleus, and without repulsion from the nucleus the small particles would not be driven towards the hyperbolic envelopes which frequently form round the nucleus. According to my theory the repulsion from the nucleus is due to a bombardment of gaseous particles, while the repulsion from the sun is due to the recoils accompanying evaporation, not of the substance of the liquid or solid particle itself, but of matter deposited on its shaded side.

Mr. Davis is right as to the velocity produced by slow evaporation of the half of a particle, but he has omitted to notice that I assumed that the half of the mass was "*rapidly* thrown off." I should have said *suddenly* thrown off, and then my numerical example would have been perfectly accurate; but the theory in no way rests upon this numerical result. I am only concerned to prove that recoils from evaporation will give rise to velocities which are commensurable with the velocities of gaseous molecules at similar temperatures.

Mr. Davis's example, in which he supposes the repelled body to be a gramme of sand contained in a block of ice equal to a cubic mètre of water can hardly correspond to the probable condition of matter about the nucleus of a comet which has made several returns to perihelion, yet such comets occasionally throw out large tails; and by making this extraordinary and somewhat artificial assump-

tion, Mr. Davis only obtains a velocity of 295,000 miles per day, whereas velocities of at least five or six million miles a day have to be accounted for. But there is no difficulty in conceiving that a minute precipitated particle while in the region of gaseous bombardment around the nucleus may receive and throw off again towards the sun a continuous stream of matter many times its own weight per hour. I hope that Mr. Davis will not imagine that because I have ventured to make this criticism, I do not consider his numerical evaluation of the repulsive force due to evaporation to be an important contribution to the subject; and I am sorry that he should feel hurt at my not having mentioned his discussion, but I had already far exceeded the limits usually allowed to papers in KNOWLEDGE. A. COWPER RANYARD.

COMETS' TAILS.

[751]—Mr. Ranyard's interesting suggestions as to the formation of comets' tails in KNOWLEDGE, No. 68, p. 100, may, I think, be supplemented by further considering the effect of *different* velocities among gaseous molecules. Supposing a comet to be a swarm of stones exhaling occluded gases under the sun's heat, the molecules of the gas at the moment of escape are closely packed together, and are, therefore, moving in all directions with individual velocities varying from the point of momentary rest to a speed many times greater than the mean, and in this condition they pass at once into that "fourth state of matter" in which each molecule becomes a separate projectile, discharged in some direction and with its own proper velocity into space. As the comet's mass is too small to be effective, the path of each molecule will depend on its own motion and the attraction of the sun. Those moving directly towards the sun will fly straight on with accelerated speed; those moving at any angle to this line of direction will take curved paths, diverging from each other. But those moving directly away from the sun will pursue the same straight line with retarded speed; each one flying to a distance determined by its own initial velocity and then falling back along the same line. The greatest distance to which any of them can fly will be that due to the greatest velocity acting against the sun's gravity at the starting point, and may evidently be very far in excess of anything we could infer from the mere velocity of the gas. On their return, the falling molecules will meet the ascending ones, their encounters being more frequent as the nucleus is approached. There will obviously be a stream of them extending as far as the greatest distance of projection in a line away from the sun, and a gradual condensation of this stream from its extremity towards the nucleus.

We seem here to have at least one efficient cause for something very like a comet's tail. ALBERT J. MOTT.

March 5, 1883.

VALUE OF GOLD.

[752]—About a week ago, Mr. Goschen, in the House of Commons, warned the members that before the Land Bill could be properly viewed, it would be necessary to bear in mind (and the fact was directly accepted by Sir Stafford Northcote on his authority) that gold had risen in value 18 per cent. within the last dozen years. Now, if this means anything, it means that the purchasing power of gold is greater by 18 per cent.; and that thus the farmer is paying 18 per cent. more rent than he was a dozen years ago. I should esteem it a favour on behalf of many of your readers if you would elucidate this matter for us, first, by telling us how any increment or decrement in gold value is felt and arrived at by financiers, and, secondly, by what links in a chain of cause and effect it is felt by the farmer. You solve puzzles for us, and some of us are more than vague here. RUSTICUS.

[I leave this question for those better able to deal with it. Mr. Goschen's statement is vague, but probably referred only to the relation between gold and land in a particular place.—R. P.]

VIBRATIONS OF STRETCHED STRING.

[753]—If a string, say 10 feet long, vibrate ten times per second, and when stopped off by half its length vibrates twenty times per second, and when stopped off by three-fourths of its length vibrates forty times per second, by how much must it be stopped off to vibrate fifteen times per second? H. G. A. BROWN.

[The law indicated is that the number of vibrations is inversely as the length of the unstopped portion. Wherefore we must have length unstopped for fifteen vibration $= \frac{10}{15}$ length $= \frac{20 \text{ feet}}{3}$ $= 6\frac{2}{3}$ feet; or $3\frac{1}{3}$ feet must be stopped off.—R. P.]

OPTICAL KNOWLEDGE OF THE ANCIENTS.

[754]—The collection of gems, Assyrian, Egyptian, and Grecian, in the British Museum—ask any expert whether the majority of these could have been executed without the aid of magnifying power? What credit is to be attached to the statement that Archimedes invented a machine of glass which faithfully indicated the motion of the heavenly bodies, or that he set fire to the Roman ships by means of burning glasses? The first determination would go far towards settling the statement concerning the Syracusan geometrician and engineer. W. CAVE THOMAS.

RELIGION AND CLASSICS.

[755]—First, Why do you continue insidiously to carp at religion, when you profess *to have nothing to do with it?*

Secondly, Why do you rail against classical education, when the wisest sentiments of all ages (mixed, it is true, with much foolishness and ignorance) are enclosed within the boards of classical works, and no one can be a good scholar without classical education? subscribe to your work, viz., KNOWLEDGE, with *much misgiving*.

REV. URBAN SMITH.

[Mr. Smith's first question reminds me of the question shouted to a candidate for election to Parliament, "Answer, Yes or No; *have* you left off beating your grandmother?" I cannot answer *why* I continue insidiously carping at religion, for the simple reason that I have never begun carping at religion. The follies of religionists are not religion. I suppose Mr. Smith refers to the remarks in "Science Gossip" on certain prayers characterised as akin, when rightly apprehended, to profanity; but exception was taken to profanity, not to prayer *per se*. That no profanity was intended is, of course, obvious enough. Not a reversal of the laws of nature, but a change to be brought about by those laws was asked for. The difficulty to the student of nature is to determine where any change can be wrought without an interruption of natural laws. When William IV. was asked to sanction prayers for drier weather, he said "They ought to pray for a change of wind," knowing, as a sailor ought to know, that drought and wet depend on wind. Science sees a natural cause lying behind the change of wind; and suspects a natural cause—not necessarily a sun-spot change—behind that again. The more we know, the farther back we can trace the chain of natural causation. If we knew the whole series of relations, asking for a change of weather would be at once seen to mean either, (1) asking for what was *bound* to happen in consequence of the natural relations involved, or else (2) asking for what *could* not happen without a miracle. The only difference between asking for such a miracle and asking that—say—a shipful of souls should be saved (when water had filled the ship) by a temporary cessation of the action of gravity, is that in one case we ask for what would not be obviously miraculous, though really so; in the other we ask for what would be very obviously a miracle. There is no connection between this question and religion, properly understanding the word. Every reasoning mind recognises that it is the mental attitude in prayer that is desirable, rather than any belief in the direct influence of prayer; and there is as much of a religious nature in patient submission as in earnest appeal. I know several persons eminently religious in the truest sense of the word, self-sacrificing and devoted, faithful and zealous in the discharge of every duty, persons whose whole life is a religious lesson, who yet—even in the time of direst trouble and anxiety, watching by the bed on which a much-loved child lies seemingly near death, longing for the safe return of those dear to them from some most dangerous journey, or themselves suffering intense bodily torture,—would feel ashamed to use any form of prayer except that found in the last part of the appeal of Gethsemane. I am not concerned with the rightness or wrongness of these views, only with the consideration that the question (as touched on in the note referred to) has, in reality, nothing to do with religion, still less with any form of dogmatic theology. The most depraved and brutal savage prays when he curses the beneficent rays of the sun because they are too warm for his personal comfort, or when he asks the particular god of his tribe to scatter the enemies of his chief, confound their politics, frustrate their knavish tricks, and make them fall; while one whose whole life and thought are pure and unselfish, may refrain, through purely religious motives, from all prayer for what he most desires. Religion, which is the quality holding a man back from wrong-doing and selfishness, and binding him to duty and loyalty and devotedness, tells nothing either way, and was in reality not thought of when that note was penned.

On Mr. Smith's second point, I note simply that it is *because* so much of wisdom is enclosed in classical works that many object to what is called—absurdly enough—a classical education. How much of the wisdom of the ancient Greek and Latin writers, how much of the grand stories some of them have told, do nine hundred and

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ninety-nine out of every thousand men who have had what is called a classical education even read—to say nothing of remembering? This is true even among men who take honours in classics at our Universities. Taking at 1,000 the number of youths who take a degree each year at our Universities (a most unfair selection for my argument), how many does the Rev. U. Smith suppose to be good scholars (even in his apparently rather restricted sense of the words), and of these how many know much about the wise sayings of men of old times? The outside of the cocoa-nut is laboriously scraped, and here and there a grain or two of the fruit may be got out, though spoiled by the scrapings of the shell; but how many learn the true flavour of the solid and liquid food within? —R. P.]

THE RAINFALL OF 1882.—DURATION OF SUNSHINE.

[756]—Perhaps some of your readers would contribute a few notes on the rainfall of the country? Fresh evidence of the comparative wetness of different parts of these islands would be valuable. At Killarney, five miles to the N. of the summit of Mangerton, and eleven N.E. of Carntual, the rainfall for 1882 was 58·5 inches; in the Gap of Dunloe, near the top of the Upper Lake, it amounted, for the eight months ending Jan. 2, 1883, to 68·6 inches.

While on the subject of comparison of climates, may I add that it is very desirable that some instrument cheaper in price for recording the duration of sunshine than the so-called Campbell Sunshine-recorder should be invented. There is no use, for purposes of agriculture, &c., in obtaining statistics of the maximum heat in the sun, unless we are also enabled to compare localities and years *inter se*, as to duration of bright sunshine; and £10 to £12 is a high price for an instrument of this kind.

G. R. Wynne.

THE WEATHER PROPHECIES.

[757]—Having read with much interest the remarks on this subject which appeared in Knowledge some few weeks ago, I have, during the past month of February, been taking daily observations, in the hope of possibly throwing a little further light upon the disputed question of the value of these forecasts.

The plan adopted was similar to that of Sir Edmund Beckett. I divided a sheet of paper into two columns, placing on the left the daily forecasts for "England, N.E.," and on the right, the weather as observed at Newcastle. I will not trouble you with the tabular statement, but will merely submit an epitome of the result. They are deduced from twenty-three days in February; four of the others were Sundays, when no forecast was at hand, and on the remaining one, the 13th, I inadvertently omitted to enter any record.

I have had regard to these elements:—(1) The direction of the wind; (2) Its intensity, and (3) The amount of rainfall.

1. *The Direction of the Wind.*—This is, as a rule, not very precisely foretold, but is given as lying between certain assigned limits, *e.g.*, "S. to S.W.," and there is, therefore, difficulty in estimating how far each prediction has been fulfilled. My method was as follows, and, though open to the objection of being arbitrary, it serves, I think, to give a good general idea of the success of the prognostics. I arranged the results in four series, A, B, C, and D. When the average direction of the wind for the day lay between the prophesied limits, I put that day under A. When the direction deviated from the mean of those limits by less than 45° (one-eighth of the compass), I put the day under B. When it deviated by more than one-eighth but less than one quarter of the compass, I put it under C, and when by more than a quarter, under D. Here, then, are the total number of days in each series:—

A	B	C	D
11	5	3	4

I shall be inclined to call A right, B nearer right than wrong, C nearer wrong than right, and D altogether wrong. In half the cases, then, we may fairly say the prophets were correct, in eight they were doubtful, and in four they were complete failures. A striking instance of the latter occurred on February 17th, when a strong cold E wind blew over Newcastle the whole day, though the office announced "S.W. or S. winds."

2. *Intensity of Wind.*—The forecasts under this head were mostly too vague to admit of close criticism. Thus:—Feb. 21. "Moderate to fresh or strong." The most definite predictions were those for gales, and these were remarkably accurate. Thus gales or strong winds were foretold on ten days, and on eight of these we had them. The total number of very windy days was ten, seven of which had been predicted. Thus on only two days was a gale predicted which did not come; while out of ten gales actually experienced warning had been given of seven.

3. *Rainfall.*—Here the Office seems to have gone lamentably astray. Out of eleven days whereon rain was predicted it only fell on four, and several of the other seven were exceptionally fine. On the other hand, fine weather was definitely foretold for four days, and on three of these it was experienced. For the rest the predictions were delightfully indefinite, but generally managed to steer clear of accuracy. Thus:—

	Forecast.	*Observed.*
Feb. 2.	Fair to unsettled	Heavy rain all day.
„ 15.	Showery to fair.....	Bright and sunny.
„ 16.	Fair to cloudy and unsettled.....	Very bright and fine.
„ 24.	Fair to unsettled and showery ...	Very bright and fine.

Of course, one month is too short a time to afford ground for general conclusions, but taking these observations in conjunction with others made casually at various times within the past few years, I incline strongly to Mr. Williams' opinion, that the wind prophecies are, on the whole, reliable, but that the rest are utterly valueless. After all, however, a foreknowledge of the wind, and especially of heavy gales, is the most important thing for practical purposes, and this is just where the office renders greatest service. Surely, if warning can be given of seven gales out of every ten in time to prevent captains from putting out of port, and to saving valuable lives and property, the existence of the Meteorological Department is amply justified.

Permit me, in conclusion, to wish you every success in your endeavours to disseminate scientific knowledge, and believe me,

Newcastle-on-Tyne, *March* 3. R. H. Jude.

THE WEATHER FORECASTS.

[758]—If "Another Observer" (letter 749, p. 153) will turn to "Good Words" for August, 1881, p. 570, he will find the secretary of the Meteorological Department, in a burst of candour, saying: "As regards the possibility of really predicting the weather for these islands, weeks or even days beforehand, it is the duty of all honest meteorologists to warn the public against expecting what is clearly impracticable." This is the bald and literal truth. That the Meteorological Office is a waste of public money may well be contended, yet it is fair to the officials to say that they *try* to do something for their money. No such excuse, however, can be advanced for the so-called "Meteorological Council of the Royal Society," a body which annually picks the public pocket of £1,000, and whose sole *raison d'être* is the private pecuniary benefit of certain "guinea-pig" F.R.S.'s who are not ashamed to receive national money under false pretences.

A Third Observer.

MULTIPLICATION—MOON'S VERTEX.

[759]—Recently I was told of a dodge for multiplying together numbers between 12 and 20. The idea may be new to some of your readers—as it was to me. Take the sum of one quantity and the last digit of the other, and underneath it in imagination, but one place to the right, put the product of the two last digits of the number. For instance:—

16×17 $\quad 16+7=23$, $\quad 6\times 7=42$, $\quad 272$

14×19 $\quad 14+9=23$, $\quad 4\times 9=36$, $\quad 266$

There is no difficulty whatever in doing this mentally. I often find it convenient. The reason will be obvious when we consider that—

$$(10+a)\,(10+b) = 10\,(10+a+b)+ab$$

Your direction, on page 11, for finding vertex by great circle passing through observer's zenith has rather puzzled me. The vertex so found would vary with observer's longitude, and the angles of position would correspondingly vary—so it seems to me. I have wondered whether you did not intend to say the great circle through the *pole*, but have seen no correction.

Fred. C. Green.

[Mr. Green should have addressed his second remark to "F. R. A. S.," not to me. I am a Fellow of the Royal Astronomical Society, though I have long since ceased to attend meetings; but I am not *the* "F.R.A.S." who has so long written in the *English Mechanic*, and in Knowledge since it started.—R. P.]

A CLEAR THAMES!

[760]—Can you give any reason for the unusual transparency of the river Thames? It is a beautiful emerald green even so low down as the Temple Embankment, and the snow-white foam which

falls from the many paddle-boxes of the steamers plying to and fro is very remarkable. I was told by a captain that it is due to the late heavy rains, which have thoroughly scoured the river. Is this so? FREDERICK J. STEVENSON.

DEAD POINT IN TRICYCLE CRANKS.

[760]—I am surprised that your experienced tricycling correspondent should fall into the common confusion of engine-cranks with tricycle-cranks. He says [Vol. III., No. 68.] "Each foot controls a pedal over little more than one third of a revolution." But the action of the knees and ankles and the friction of the sole on the pedal all make the analogy of a piston-rod crank quite misleading.

Remove the chain or "intermediate gear" of a tricycle, so that the crank runs freely without driving anything. Sit on the seat, and you can turn the crank either way, fast or slowly, stopping or starting at any point in the circle, and deriving no help from "momentum." Except on an ascent, or on very soft or lumpy roads, a tricycle can be started at any point in the turn with a very little practice. There is still a *weak* point, but no *dead* point.

D. M.

STAYS.

[761]—I can quite confirm the statement of Mr. Behnke as to the influence of the stays on the breathing capacity of the chest. As one instance of many—I this week saw a young lady who, her height being under 5 ft., should have a vital capacity of about 125 cubic inches, who could not breathe into the spirometer more than 78. On removal of her stays, which were by no means tightly laced, she at once, and with the greatest ease, breathed 118 cubic inches. I am happy to add that she was so struck by this fact, that she refused to resume the corset, but carried the article away with her, wrapped up in brown paper. LENNOX BROWNE, F.R.C.S.

CHIRPING SPIDER.

[762]—I fear my language was inaccurate, and misled "S. H. W." [737]. I am quite familiar with the cricket's provoking "tweet," and I have heard the "Death Watch's" tap unscathed; but my spider made a note like the scratching of a little finger-nail on a linen tablecloth, or the cutting of hardish paper with a paper-knife, in short notes repeated at the rate of from sixty to eighty a minute, pretty regularly. I am convinced he was a spider, and I think my letter (Vol. III., No. 66, 700) shows I took care to make sure. But I asked a friend to come and help me to catch, examine, and describe the creature. The chirping ceased before he could come, and on looking I found the web empty and transparent, without even a cast skin left behind.

My landlady, once a housemaid, assures me she has heard big spiders emit a sort of soft hissing sound. D. M.

LETTERS RECEIVED.

A letter (on an exegetical subject) has been sent to Editor to be forwarded to Mr. E. L. Garbett. We have not Mr. Garbett's address, but will retain the letter till sent for by him.—Jas. Watson, jun.—H. J. M. Untenable.—E. P.—Alf. Peters.—M. R. Name *not* Sir G. B. Airey.—R. M. Subject scarce suitable. Are not suspenders always replaced by belt for active exercise?—A. J. Dove, C. W. Bownie, H. J. Bell, H. H. Higgins, G. G. Warren, Scot, J. Abbot, B. A., J. J. Martin, Rev. Urban Smith, and others. Only the profanity of certain prayers objected to; not prayer in general. Some of you seem to think none but Christians ever pray; but Jews, Mahomedans, Buddhists, all sorts and conditions of men, in fact, pray energetically.—L. Gordon Rylands.—A. M. S.—J. Samuel. More rotations on outer curve, except by crank-connected wheels, whose rotations must be the same in amount, wherefore in their case there is slip.—W. H. S. Monck.—E. A. You are probably right; but some would object to subject.—T. F. R. Subject to be treated shortly.—Mrs. Jas. Jackson.—C. T. Gray. You mistook last vertebra for a sting.—A. J. Mott.—T. Preston Battersby.—M. A. R.—Bios. Theory of planet formation quite misunderstood by you; planets probably not thrown off from sun.—W. B.—Upsala.—A Country Clergyman. I prefer a reflecting telescope, but others like refractors best; of the two you name, the larger instrument is relatively the cheaper, the smaller is the better for its size, and the handier. The question would not do for discussion, as it introduces trade considerations.

Our Mathematical Column.

BY RICHARD A. PROCTOR.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

(*Continued from Vol. II.*)

I HAVE for some time deferred the rest of these lessons, having been asked to give some easier subject (though, in truth, the Differential and Integral Calculus, as I am treating it here, is easily within the range of anyone who has mastered the elements of Algebra, Trigonometry, and Geometry). I now continue these lessons, which will presently reach their conclusion.

In the preceding lessons, those integrals which are at once derivable from known differential coefficients were indicated and collected into a table (Vol. II., p. 473), and then two simple processes for integration—integration by substitution and integration by parts—were considered at p. 501. There is another process, called integration by reduction, which may be considered later. But I propose now to consider certain useful integrals which may be obtained by the processes already described. I shall treat them in a rather novel manner, though there will be nothing new in the matter presented.

AREA OF A CIRCULAR SECTOR.

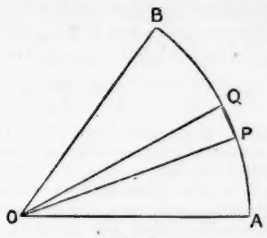

Fig. 1

Let A B (Fig. 1) be a circular arc round the centre O, and let it be required to determine the area of the sector A O B, where A O = r and $\angle$ A O B = a.

Let P Q be a small element of the arc A B. Let $\angle$ A O P = θ; $\angle$ Q O P = $\delta\theta$.

Then if Q P be joined, triangle Q O P = O P . O Q sin Q O P

$$= \frac{r^2}{2} \sin \delta\theta.$$

And when $\delta\theta$ becomes $d\theta$, or is made indefinitely small,

$$\sin \delta\theta = \delta\theta, \text{ and triangle } Q\,O\,P = r^2\,d\theta.$$

Hence, since area A O B is manifestly equal in the limit to the sum of all such triangles as Q O P in the sector, when their number becomes infinite, we have

$$\text{Sector A O B} = \tfrac{1}{2}\int_0^a r^2\,d\theta = \frac{r^2}{2}\int_0^a d\theta.$$

Now we know that—

$$\int d\theta = \theta + C,$$

where C is some constant (which need not trouble us). Therefore—

$$\text{Sector AOB} = \frac{r^2}{2}\Big(a + C - \overline{0 + C}\Big) = \frac{r^2}{2}.a$$

That is, the area of a sector is represented numerically by half the product of the numbers representing r the length of the radius, and ra the length of the circular arc.

Observe that we learn nothing new from this application of the integral calculus. It does not tell us what the length of the arc is; nor is anything derived from the calculus in the recognition of the relation between the area on the one hand and the arc and radius on the other. When we take $a = 2\pi$ so as to get the whole circle, we find that the area of the circle is represented by the product of the radius and the circumference.* But our modern method has

* I write thus for shortness. As a matter of fact, an area can no more be represented by the product of two numbers representing lengths, than a period of time can be represented by a number of acres, or the content of a solid by a number of hours. Such an expression as the above means only that certain units being taken, the relation indicated exists between the numbers mentioned. Thus, if we say that the area of a rectangle is represented by the product of its sides, we mean really that if a square on the unit of length is taken as the unit of area, then the area of a rectangle is represented numerically by the product of the numbers representing the lengths of two adjacent sides.

not squared the circle for us; for it has not shown the length of the circumference, or of the arc AB in the particular case dealt with.

It is only because we *know* the lengths of circular arcs that our result is really a determination of the area of the sector

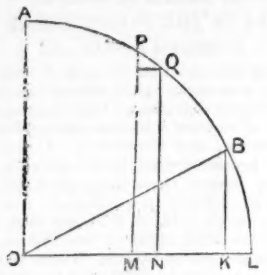

Fig. 2.

Suppose, now, we wish to determine by means of the integral calculus the area O A B K (Fig. 2), where A B L is a quadrant.

We have already determined the area in what precedes; for, joining O B, we know the area of sector A O B, and adding thereto the triangle O B K, we have the total area O A B K.

Thus if radius $OA = a$, $OK = x_1$, then $BK = \sqrt{a^2 - x_1^2}$; and arc $AB = a \sin^{-1}\left(\frac{x_1}{a}\right)$. Hence area O A B K = triangle O B K + sect. A O B

$$= \frac{x_1\sqrt{a^2 - x_1^2}}{2} + \frac{a^2}{2}\sin^{-1}\left(\frac{x_1}{a}\right)$$

But suppose we wish to determine the area O A B K independently, by the summation of such rectangular strips as Q M, made in the limit indefinitely narrow.

We put $OM = x$, $MN = \delta x$. Thus we have—

Rect. $QM = \sqrt{a^2 - x^2}\,\delta x$; and area O A B K = sum of all such rectangles made infinite in number, and so taken indefinitely thin, between O A (where $x = 0$) and B K where $x = x_1$.

Thus Area $OABK = \int_0^{x_1} \sqrt{a^2 - x^2}\,dx$.

Now, to integrate $\int \sqrt{a^2 - x^2}\,dx$, we may try the method of integration by parts, noticing that unity is the differential coefficient of x with respect to x. Thus—

$$\int \sqrt{a^2 - x^2}\,dx = \int \frac{dx}{dx}\sqrt{a^2 - x^2}\,dx$$

$$= x\sqrt{a^2 - x^2} - \int x \frac{d}{dx}\sqrt{a^2 - x^2}\,dx$$

$$= x\sqrt{a^2 - x^2} + \int \frac{x^2 dx}{\sqrt{a^2 - x^2}} \qquad (1)$$

But here we notice that $\frac{x^2}{\sqrt{a^2 - x^2}} = \frac{x^2 - a^2 + a^2}{\sqrt{a^2 - x^2}}$

$$= -\sqrt{a^2 - x^2} + \frac{a^2}{\sqrt{a^2 - x^2}}$$

So that $\int \frac{x^2 dx}{\sqrt{a^2 - x^2}} = -\int \sqrt{a^2 - x^2}\,dx + a^2 \int \frac{dx}{\sqrt{a^2 - x^2}}$ (2)

the first part of which, when written in equation 1, will clearly give us what can be conveniently taken over to the other side with a positive sign, while the other part is in our table of known integrals at p. 473. Thus, substituting in (1) from (2) and transposing, we get:—

$$2\int \sqrt{a^2 - x^2}\,dx = x\sqrt{a^2 - x^2} + a^2 \int \frac{dx}{\sqrt{a^2 - x^2}} = x\sqrt{a^2 - x^2} + a^2 \sin^{-1}\frac{x}{a}$$

Or, $$\int \sqrt{a^2 - x^2}\,dx = \frac{x\sqrt{a^2 - x^2}}{2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}$$

Putting 0 for x in this we get 0; so that

$$\int_0^{x_1} \sqrt{a^2 - x^2}\,dx = \frac{x_1\sqrt{a^2 - x_1^2}}{2} + \frac{a^2}{2}\sin^{-1}\frac{x_1}{a}$$

This, therefore, is the required area O A B K.

Remembering that this area O A B K can be divided into the triangle O B K and the sector A O B, we have a ready means of *remembering* as well as of *interpreting* the important relation

$$\int \sqrt{a^2 - x^2}\,dx = \frac{x\sqrt{a^2 - x^2}}{2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}$$

We have given the solution for this integral, as it might be found out by one seeking it without a knowledge of the book method. Having found it, we can conveniently write the solution thus:—

$$\int \sqrt{a^2 - x^2}\,dx = x\sqrt{a^2 - x^2} + \int \frac{x^2 dx}{\sqrt{a^2 - x^2}}$$

Also, $$\int \sqrt{a^2 - x^2}\,dx = \int \frac{a^2 - x^2}{\sqrt{a^2 - x^2}}\,dx = \int \frac{a^2 dx}{\sqrt{a^2 - x^2}} - \int \frac{x^2 dx}{\sqrt{a^2 - x^2}}$$

$$\therefore \text{ adding, } 2\int \sqrt{a^2 - x^2}\,dx = x\sqrt{a^2 - x^2} + \int \frac{a^2 dx}{\sqrt{a^2 - x^2}}$$

$$i.e. \int \sqrt{a^2 - x^2}\,dx = \frac{x\sqrt{a^2 - x^2}}{2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}$$

But the student who really wants to understand what he is doing should work out such results in some such way as he would in actual practice, not follow simply the conveniently abridged methods which are formed *after* a result has been obtained.

Our Whist Column.

By "Five of Clubs."

PLAYING TRUMPS—(*continued from* p. 153).

I HAVE been careful to consider first the cases in which a backward game should be played with regard to trumps, and the book rule about passing doubtful cards neglected; because so many games are lost through a rigid adherence to a rule which is often misunderstood. As a matter of fact, the rule is not properly stated. Strength in trumps is not a sufficient reason for refraining from ruffing, if such weakness in plain suits has been shown as to suggest a backward game. The rule should rather run, So long as there is nothing to show that between trumps and plain suits you and your partner can hold your own against the adversaries, refrain from ruffing a doubtful card from a four-card trump suit; and equally, Under the same conditions, refrain from forcing your partner if, being yourself weak in trumps, you have reason to think he may be strong.

But turning now to cases where there is no special reason to play either a backward or a forward game, we see the reason in these—which includes the majority of cases—for the book rule. In every Whist hand in which the forces are fairly divided there may be said to be on the average sixteen tricks in the four suits, of which only thirteen can possibly be taken; and thus in every fairly matched Whist hand there are two or three tricks which one or other side will make or lose, according to the skill or good fortune with which the hand is played. Of course, in the play of each suit there is room for skill and good fortune to tell, in the finesse and so forth; but we are considering, just now, the total number of tricks to be made, whether by finesse or otherwise, in the several suits, if each could "tell" to the last card in it. Now, as a matter of fact, this, as a rule, is only the case with trumps, though it may happen with any established suit after trumps are exhausted. In trumps there may be more than the natural number of tricks, because trumps may take tricks singly.

But a time comes in every well-matched hand of Whist when the question which side will make the most of its long plain suits (by which is to be understood every suit of more than three) depends on the manipulation of trumps and forcing cards. All may then turn on the possession of a trump more or less, on one side or the other. Forcing a hand which holds more than the average number of trumps thus very often means the gain or sacrifice of one trick (according as it is your partner or the adversary who is forced) for two or three tricks. This is so commonly the case in well-matched hands, or hands which have become well matched so far as what remains of them is concerned, that we get almost as standing rule in such cases, Refrain from forcing your partner if you are weak in trumps and he probably strong; Pass a doubtful card if you hold more than the average number yourself; and Force the adverse strong trump hand.

But these rules do not apply to very weak hands, even though there is numerical length in trumps; nor, on the other hand, do they apply to very strong hands, which can often afford to ruff and wait, or even to ruff and lead trumps.

The determination of the proper time for leading trumps in the case of fairly-matched hands not justifying either a signal or an early lead of trumps, still remains among the most difficult points of Whist strategy. It may generally be taken for granted that a late lead of trumps, unless obviously forced, is to be respected by

partner as much as an early lead, though not quite so scrupulously as the signal. Such a lead means that from the observed fall of the cards in the different suits the trump leader sees a good prospect of bringing in one or other of the long suits which he or his partner possesses, and has by this time probably established.

Again, it is to be noticed that in leading trumps late, backward play in that suit is usually advisable. For though forward play may secure the drawing of more rounds, it risks throwing the command in trumps into the adversaries' hand—who, in the case we are considering, of hands originally well matched, may need only this advantage to gain all the good from your lead of trumps which you had hoped to secure for yourself and your partner. Thus, we see the reason of the difference already indicated between the various leads in trumps and in plain suits. The leads in plain suits aim as much at making the good cards held in the suit as at finally establishing it; the leads in trumps aim chiefly at winning the closing rounds in trumps, or remaining at least with a long trump or a winning card in the enemy's suit to bring in an established suit. For similar reasons, you may finesse more deeply in trumps than in plain suits; but not in the *first* round to your partner's lead.

Great judgment, then, is required, where hands are well matched, in deciding whether, or when, to lead trumps, and in managing trumps after they are led.

It is hardly necessary to say that in the return of the trump lead most careful attention should be given to the rule for returning from long or short suits. It is bad enough to mislead a partner by returning the lowest of a short suit, or the highest of a long suit, (though *this* mistake is not often made); but in trumps it is a fatal error. He counts one more trump in your hand than you really have, and therefore one less in the enemies' hands; he miscounts the other suits also; and his whole strategy is disarranged.

As to the play third in hand to your partner's lead, that has been already considered.

It remains that I should consider the lead of trumps from great strength—first in trumps only, secondly all round.

(To be continued.)

AN American engineer, who, being engaged in the construction of a railway in China, has had unusually favourable opportunities of examining the famous Great Wall, built to obstruct the incursions of the Tartars, gives the following account of this wonderful work:—"The wall is 1,728 miles long, 18 ft. wide, and 15 ft. thick at the top. The foundation throughout is of solid granite, the remainder of compact masonry. At intervals of between 200 and 300 yards towers rise up 25 ft. to 40 ft. high, and 24 ft. in diameter. On the top of the wall, and on both sides of it, are masonry parapets, to enable the defenders to pass unseen from one tower to another. The wall itself is carried from point to point in a perfectly straight line, across valleys and plains and over hills, without the slightest regard to the configuration of the ground, sometimes plunging down into abysses 1,000 ft. deep. Brooks and rivers are bridged over by the wall, while on both banks of larger streams strong flanking towers are placed."

M. POISOT lately communicated to the *Société de l'Industrie Minérale de Saint Étienne* some useful information as to the means for preventing the slipping of locomotive wheels in the Mazenay mines, no more fuel being now employed for hauling out 100 tons than the eighty formerly. He observes that the ventilation is effected by diffusion, and there is constantly in the rolley way a tolerably thick smoke, which with condensed steam from the engine and the dampness of the workings causes the rails to be slippery. The consequence is that every time they tried to ascend the gradient of 1 in 66 with a full train, they could only get up half of it, about 180 mètres—590 ft.—without the wheels beginning to spin; and during the rest of the rise, notwithstanding the use of fine and dry sand, this difficulty frequently began again, so that they lost pressure to such an extent that they were obliged to stop to make steam. This difficulty caused great consumption of fuel, excessive wear of the working parts of the engine, and a rapid destruction of the rails. About two months ago the joint of one of the cylinder cocks leaked, and a jet of steam, escaping from it, was directed on to the rail, when the train took the gradient without the engine once slipping. For two days they worked without making the repair, and the locomotive drew all the trains without the slightest stoppage. In consequence of this experience they altered the cylinder cocks so as to make them discharge directly on to the rails, and when they get to the gradient the cocks are slightly opened, so that they ascend it without difficulty. Arrangements for washing rails with a jet of water are very old, having been used on some of the French lines fifteen or sixteen years ago. The use of steam for the purpose is a simpler modification of an old idea.

Our Chess Column.

By MEPHISTO.

PROBLEM No. 80.

By A. J. MAAS, Cham (Switzerland).

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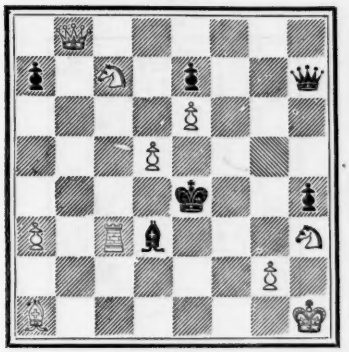


WHITE.

White to play and mate in three moves.

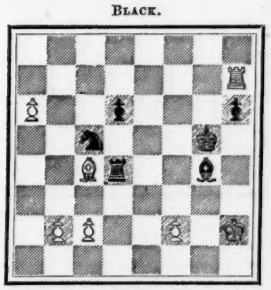
"Luck is often within reach, but you must know how to grasp it." There is some small amount of chance in everything, therefore also in chess play. But can it really be called chance when a player suddenly secures an advantage, or even terminates the game in an unexpected manner, and perhaps at a time when his opponent expected to secure victory? We are of opinion that in most cases it is skill and ingenuity that discovers the chance, and it requires fine and precise play to follow up the idea when conceived, in order to lead to a successful issue. People often have different opinions, but that is perhaps chiefly owing to vanity.

"I never played so badly in all my life!" is an expression which affords us great amusement whenever we hear it, which is usually the case when a weak player plays a first-rate player for the first time. Of course, the play of a first-rate quite bewilders him. It is something quite different to what he has been used to. Therefore his instinct suggests an excuse in keeping with his vanity. But ought he not rather to say: I never played such a good player in all my life? But such is weak mortal! he seldom takes that view of his defeat.

"You will not win this game, for a thousand pounds!" said an impulsive player to us the other day. We determined to keep a special look out for any opportunity, and it came, as the following position will show:—

AMATEUR.

BLACK.



WHITE.

MEPHISTO.

We played	R to Kt7 (ch)	K to B3
	R takes B	

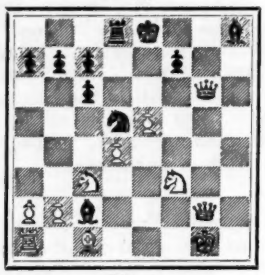
Then suddenly our opponent's fist banged the table, for he saw that he had a lost game, for if he replies with R takes R, the Pawn goes on to Queen; if Kt takes P, then R takes R wins; or if R to Q8, then P to Kt4 wins. Our discomfited adversary did not for a moment give us any credit for having been at great pains to defend our game, and so manipulate our pieces that, in spite of being a piece minus, we managed to advance a Pawn on to Rook's 6th, and that by our perseverance and special attention we met chance half

way. He emphasized his opinion by exclaiming: "You have had wonderful luck."

It can be easily imagined that in his next game our opponent put forth his best efforts to avenge his former defeat. He really obtained the superior game, as may be seen from the position below, he having on his last move played Q to Kt3, with a view of forcing the exchange of Queens. But again the cup was dashed from his grasp when near his lips. The following continuation occurred:—

Amateur.

Black.



White.

Mephisto.

B to Kt5	R to Q2
R to K sq.	Kt takes Kt

(with the intention of following this up by B to K5, and force further important exchanges, and win by superiority of Pawns.)

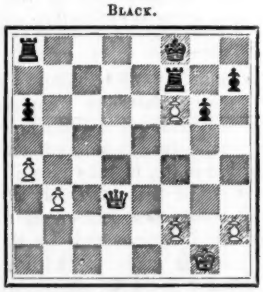
Q to R3	B to Kt2
P to K6	B takes P (ch)
K to R2	R to Q4
P takes P (ch)	K to B sq.
Q to B8 (ch)	K takes P
R to K7 mate.	

"How is it possible that I could have overlooked that simple manœuvre! You need not at all pride yourself upon your cleverness. What would you have done had I played Q to R2 in reply to your move of Q to R3? which would have made your brilliant combination impossible. It is all owing to my bad play."

The climax was, however, reached in a subsequent game. Our impetuous opponent lost his Queen for two Rooks and Pawns. He repeatedly offered a draw, saying that the Queen could not win against two Rooks. Thinking there was yet some chance left, we continued the game, and by perseverance, we gradually won some of his Pawns, and arrived at a more favourable position, as shown in the diagram:—

Amateur.

Black.



White.

Mephisto.

We played Q to Q5, attacking the Rook, which cannot move to R2, on account of Q to Q8 mate, nor to K sq., on account of Q to Q6 (ch), winning the Pawn and having two passed Pawns. Black replied with R (B2) to QR2, whereupon White won the game by the simple move P to R5, which curiously enough paralysed both the black Rooks, which dare not move; thus, if for instance R to B sq. (if anywhere else Q to B5 (ch) winning the other Rook) then White wins by Q to Q6 (ch), K to K sq., Q to K6 (ch), K to Q sq., P to B7.

In answer to P to R5, Black could do nothing but

	P to R3
K to Kt2	P to Kt4
K to Kt3	P to R4
P to Kt4	P to Kt5
K to R4	K to K sq.
K takes P	R to R7 (ch)
K to Kt6	R to R7
P to B7 (ch)	K to K2
Q to B5 (ch) and wins.	

Of course, our opponent would not be convinced, as his self-esteem was at stake. But when a player achieves success, it is our decided opinion that he must necessarily have largely contributed towards bringing about this favourable result, and due credit ought to be given to him. We admit that there is a small amount of chance, but not sufficient to exercise any continuous or appreciable influence on the general result of a prolonged series of games.

The case of Winawer, who tied with Steinitz at Vienna, for first place, forms a conspicuous example, showing how even strong players will err. In spite of his eminent success, it was said of him that he owed his position mostly to luck, and that he is not a strong player. This opinion is, of course, incorrect, but it has a grain of truth in it, nevertheless. The true definition of Winawer would be that he does not possess great powers of concentration, necessary for heavy match play. On the other hand, he possesses a ready wit in his play, sees every possible chance on the board (because he does not concentrate his mind too intensely on single points or lines of play), and displays great skill and ingenuity when he sees his opportunity to initiate a combination. These qualities are bound to lead to success in tournament play, which is generally of a somewhat lighter character than match play. Perfection is attained when a player combines both styles of play, but that being exceedingly rare, we, for our own part, cannot withhold our admiration for a player like Winawer, who achieves success by skill and ingenuity.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Tyro.—Wormald's Chess Openings.

Correct solutions received.—Problem No. 77, Kit, John Lonsdale; No. 78, S. Bassan Lello; No. 78 and 79, Clarence, W.

No. 79 has proved a hard task for our solvers, in spite of the facility afforded to them by disclosing the first moves. We hope to receive more numerous solutions by next week.

Leonard P. Rees.—Received with thanks.

Berrow.—Solution of 78 correct. In No. 79 you do not give a reply to Black moving 1. B to R4.

R. J. P.—Solution correct.

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